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TABLETS
OF
ANATOMY

BY
THOMAS COOTE, M.R.C.S.
AND
P. G. HAMERTON COOKE

ILLUSTRATED EDITION

PART I—THE BONES

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TABLETS

OF

ANATOMY.

DISSECTIONAL AND SCIENTIFIC.

BY

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PART I.—THE BONES.

(*With* 230 *Illustrations.*)

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1898.

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PREFACE.

A distinct principle runs through this Edition of the Tablets, not quite manifest, perhaps, in this Part I., but which will be more apparent in Parts II. and III.

The Authors have written for the medical student intending to become a *practitioner*. They have endeavoured to present the anatomy of the medical man* as distinct from, – but along with, – the anatomy of the scientist.

The anatomy of the medical man the Authors take to be the anatomy that can be "seen and handled" in the most matter-of-fact sense of the words, and so seen and handled *by all*.

The anatomy the scientist has developed of late years is the anatomy that only *the few* can see and handle.

The two forms of anatomy have been presented separately.

No attempt has been made at the impossible and misleading task of fusing modern, or subjective anatomy, with the objective or *dissectional* anatomy *à la* Gray, *à la* Heath, *à la* Ellis.

New facts, – or supposed facts, – not plainly discernible, – statements based upon a theory, – have been presented, not in the Tablets, but in "Notes." If other avocations had permitted, the morphology of the osseous system would have been introduced in these Notes. It will be, it is hoped, in some subsequent Edition.

* "Knife and forceps anatomy" (Mitchell Banks).

11195
MAY 25 1

Heath dealt primarily with the soft parts, and referred to the bones but *incidentally*. And, as classical writers treating specially of the Bones continued to present the old description up to quite a recent date, the Author thought himself the first in the field with the new description, which he had brought out in 1872. This honour is Mr. Heath's.

BONES OF THE TRUNK

To demonstrate in Chinese dogs as possible [illegible] Man & in other vertebrate dogs.

To study vertebræ, compare the different parts of abc. dorsum.

THE VERTEBRÆ.

Present for examination: –

Body – Forms a short column, which presents:

ANT. SURFACE – Convex from side to side, concave from above downwards; presents numerous small vascular foramina.

POST. SURFACE – Concave from side to side, flat from above downwards; presents one or more irregular apertures for exit of venæ basis vertebræ.

UPPER & UNDER SURFACES – Rough & slightly concave, and surrounded by a prominent rim.

Pedicles – Join the body to the laminæ. They are constricted, and their constriction gives rise to the

Notches – Which latter, by the superposition of the vertebræ, form the *intervertebral foramina.*

Laminæ – Broad & flat, rough above & below for the ligamenta subflava; bound posteriorly the

Foramen – Which, by the superposition of the vertebræ, forms the spinal canal.

Spinous process – Projects backwards from the point of junction of the laminæ.

Transverse processes – Two. Project outwards from the sides of the arch.

Articular processes – Four. Project upwards & downwards from the point of junction of the pedicles with the laminæ. The superior ones look backwards, the inferior ones look forwards.

N. — But little, which would be applicable to *each* of the three groups of vertebræ, can, it is believed, be added to this description.

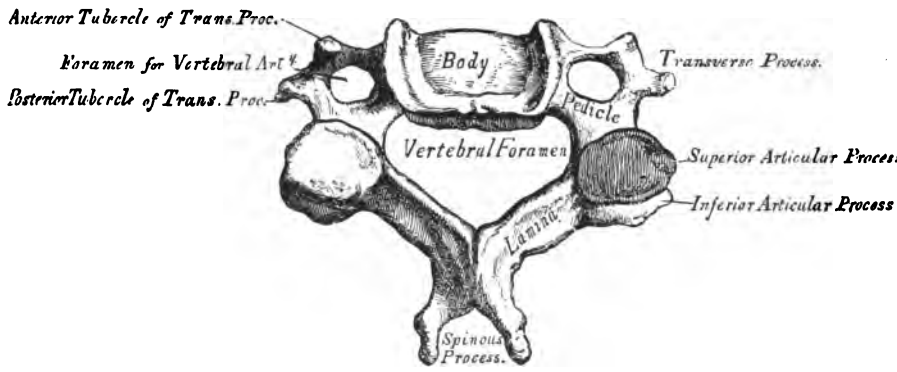


FIG. 1.—A CERVICAL VERTEBRA. (Gray.

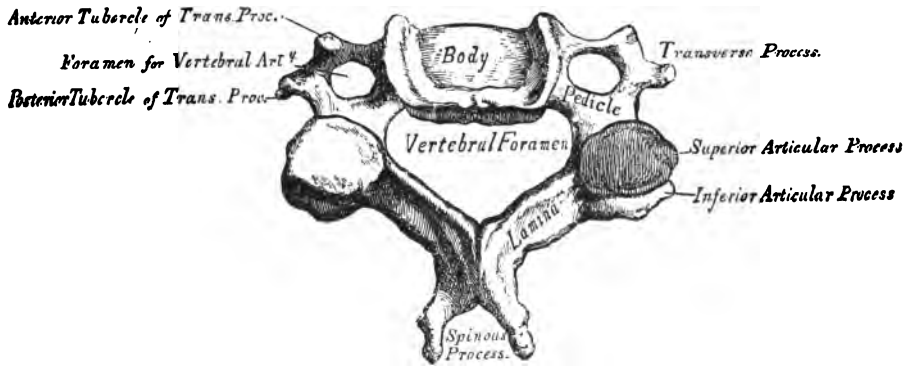


FIG. 2.—A CERVICAL VERTEBRA. (Gray.)

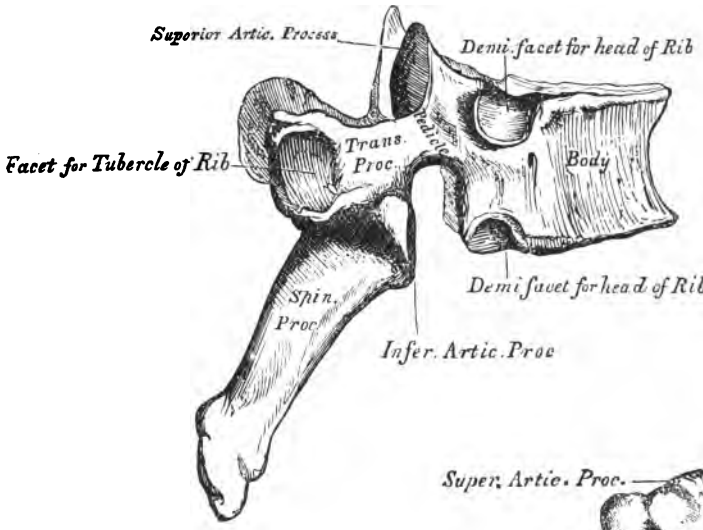


FIG. 3.—A DORSAL VERTEBRA. (Gray.)

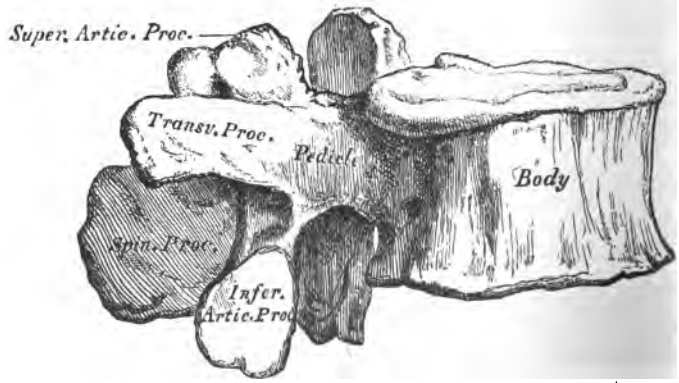


FIG. 4.—A LUMBAR VERTEBRA. (Gray.)

THE THREE GROUPS of VERTEBRÆ.

CERVICAL VERTEBRÆ — The smallest. Present: -

BODY — Small, broad from side to side. Presents: -
UPPER SURFACE - Concave from side to side, and rounded off anteriorly.
UNDER SURFACE - Convex from side to side, and prolonged downwards ante
ANTERIOR SURFACE - Situated therefore on a lower level than the posterio
PEDICLES — Arise from lower part of body, and of the two
NOTCHES — The superior ones are the deepest, and somewhat the narrowest
LAMINÆ — Long and narrow.
FORAMEN — Large and triangular.
SPINOUS PROCESS — Projects horizontally backwards, and is short, bifid, & i
TRANSVERSE PROCESSES — Short, bifid, grooved superiorly, perforated
base for passage of vertebral artery & vein, divided at their apex into
and posterior tubercles, and situated *on the outer side of the pedicles, in*
the articular p
The existence of the foramen at the base of the cervical transver
cesses, and the situation of these processes on the outer side of the pe
are owing to their being formed of two roots, which roots correspo
posterior one to the transverse processes properly so-called, the an
one to t
ARTICULAR PROCESSES — Form a small vertical column. The superior on
upwards & backwards, the inferior ones look downwards & for

DORSAL VERTEBRÆ — Intermediate in size. Present: -

BODY — Heart-shaped, thicker behind than in front, and has two demi-facets o
side, which facets articulate with the heads of th
PEDICLES — Arise from upper part of body, and of the two
NOTCHES — The inferior ones are the deepest and broadest.
LAMINÆ — Short & broad.
FORAMEN — Small & round.
SPINOUS PROCESS — Long, triangular, oblique, and ends in a single tubercl
TRANSVERSE PROCESSES — Long, thick, obliquely directed outwards & back
and situated *behind the articular processes & the pedicles.* Their extre
enlarged, and presents in front an articular facet for tubercle of corre
i
From the back of the extremity of the few lower dorsal transverse p
ses arise three tubercles, termed *external, inferior, & superior,* which tu
correspond respectively to the transverse processes of the lumbar ver
and to the accessory & mammillary tubercles found, the former on th
of the transverse processes, the latter on the back of the superior ar
processes of the lumbar ver
ARTICULAR PROCESSES — Nearly vertical. The superior ones look backw
outwards, the inferior ones look forwards & in

LUMBAR VERTEBRÆ — The largest. Present: -

BODY — Large, broadest from side to side, rather thicker in front than behind.
PEDICLES — Thick; arise from upper part of body, and of the two
NOTCHES — The inferior ones are the deepest & broadest.
LAMINÆ — Short, broad & thick.
FORAMEN — Triangular, larger than in the dorsal region, smaller than in the ce
SPINOUS PROCESS — Thick, quadrilateral, and ends in a rough vertical bord
TRANSVERSE PROCESSES — Long, slender, directed transversely outward
situated *in front of the articular processes, but behind the pedicles,* and in
with the external tubercles of the lower dorsal transverse processes, to
they corre
On the back of each, near its base, is a small tubercle the *accessory t*
which points downwards & inwards, and which corresponds to the i
tubercles on the lower dorsal transverse pro
ARTICULAR PROCESSES — Thick, strong & vertical. The superior ones are co
look backwards & inwards, and are farther apart than the inferior ones,
they embrace. The inferior ones are convex, look forwards & outward
are nearer to each other than are the superior ones.
On the back of each superior articular process is a small tubercl
mammillary tubercle, which corresponds to the superior tubercles on the
dorsal transverse pro

THE THREE GROUPS COMPARED SERIATIM.

Body – CERVICAL – Small, broad from side to side. Presents: –
Upper Surface – Concave from side to side, & rounded off anteriorly.
Under Surface – Convex from side to side, & prolonged downwards anteriorly.
Anterior Surface – Situated therefore on a lower level than the posterior.
DORSAL – Heart-shaped, thicker behind than in front, and has two demi-facets on each side which demi-facets articulate with the heads of the ribs.
LUMBAR – Large, broadest from side to side, rather thicker in front than behind.

Pedicles – CERVICAL – Arise from lower part of body.
DORSAL – Arise from upper part of body.
LUMBAR – Thick; arise from upper part of body.

Notches – CERVICAL – The superior ones are the deepest, and somewhat the narrowest.
DORSAL – The inferior ones are the deepest and broadest.
LUMBAR – The inferior ones are the deepest & broadest.

Laminæ – CERVICAL – Long & narrow.
DORSAL – Short & broad.
LUMBAR – Short, broad & thick.

Foramen CERVICAL – Large & triangular.
DORSAL – Small & round.
LUMBAR – Triangular, larger than in the dorsal, smaller than in the cervical.

Spinous Process —
CERVICAL – Projects horizontally backwards, and is short, bifid, & grooved inferiorly.
DORSAL – Long, triangular, oblique, and ends in a single tubercle.
LUMBAR – Thick, quadrilateral, and ends in a rough vertical border.

Transverse Processes —
CERVICAL – Short, bifid, grooved superiorly, perforated at their base for passage of vertebral artery & vein, divided at their apex into anterior and posterior tubercles, and situated *on the outer side of the pedicles, in front of the articular processes.*
DORSAL – Long, thick, obliquely directed outwards & backwards, and situated *behind the articular processes & the pedicles.* Their extremity is enlarged, and presents in front an articular facet for tubercle of corresponding rib.
From the back of the extremity of the few lower dorsal transverse processes arise three tubercles, termed *external, inferior, & superior,* which tubercles correspond respectively to the transverse processes of the lumbar vertebræ, and to the accessory & mammillary tubercles found, the former on the back of the transverse processes, the latter on the back of the superior articular processes of the lumbar vertebræ.
LUMBAR – Long, slender, directed transversely outwards, and situated *in front of the articular processes, but behind the pedicles,* and in a line with the external tubercles of the lower dorsal transverse processes, to which they correspond.
On the back of each, near its base, is a small tubercle the *accessory tubercle,* which points downwards & inwards, and which corresponds to the inferior tubercles on the lower dorsal transverse processes.

Articular Processes –
CERVICAL – Form a small vertical column. The superior ones look upwards & backwards, the inferior ones look downwards & forwards.
DORSAL – Nearly vertical. The superior ones look backwards & outwards, the inferior ones look forwards & inwards.
LUMBAR – Thick, strong & vertical. The superior ones are concave, look backwards & inwards, and are farther apart than the inferior ones, which they embrace. The inferior ones are convex, look forwards & outwards, and are nearer to each other than are the superior ones.
On the back of each superior lumbar articular process is a small tubercle, the *mammillary tubercle,* which corresponds to the superior tubercles on the lower dorsal transverse processes.

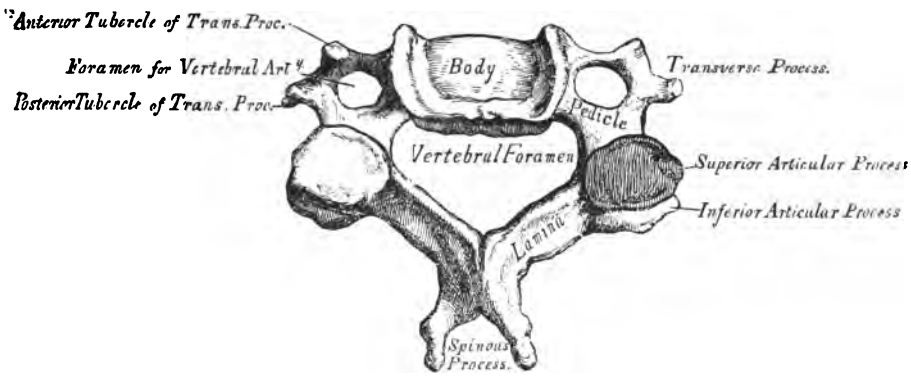


FIG. 5.—A CERVICAL VERTEBRA. (Gray)

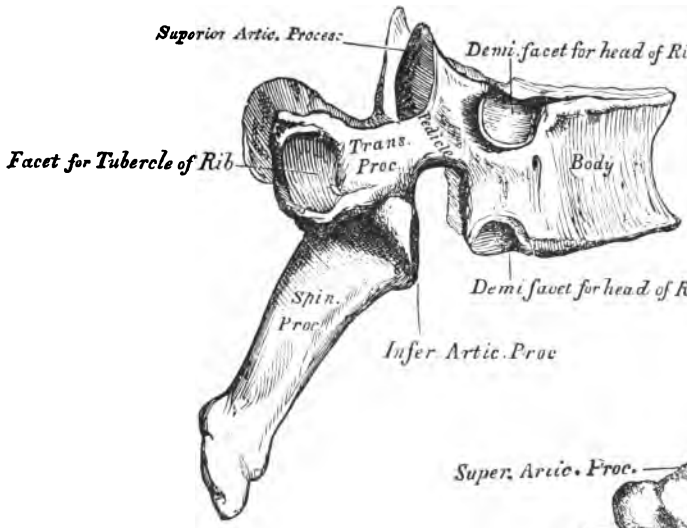


FIG. 6.—A DORSAL VERTEBRA. (Gray.)

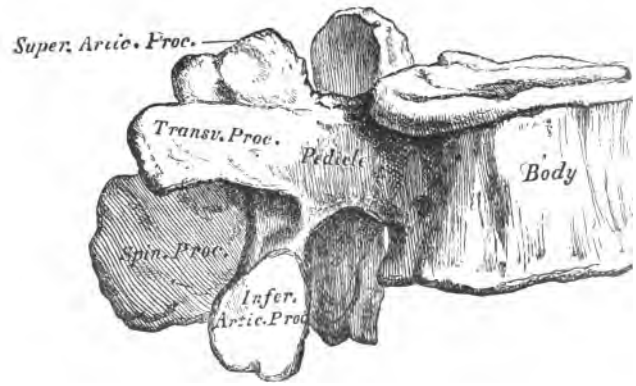


FIG. 7.—A LUMBAR VERTEBRA. (Gray.)

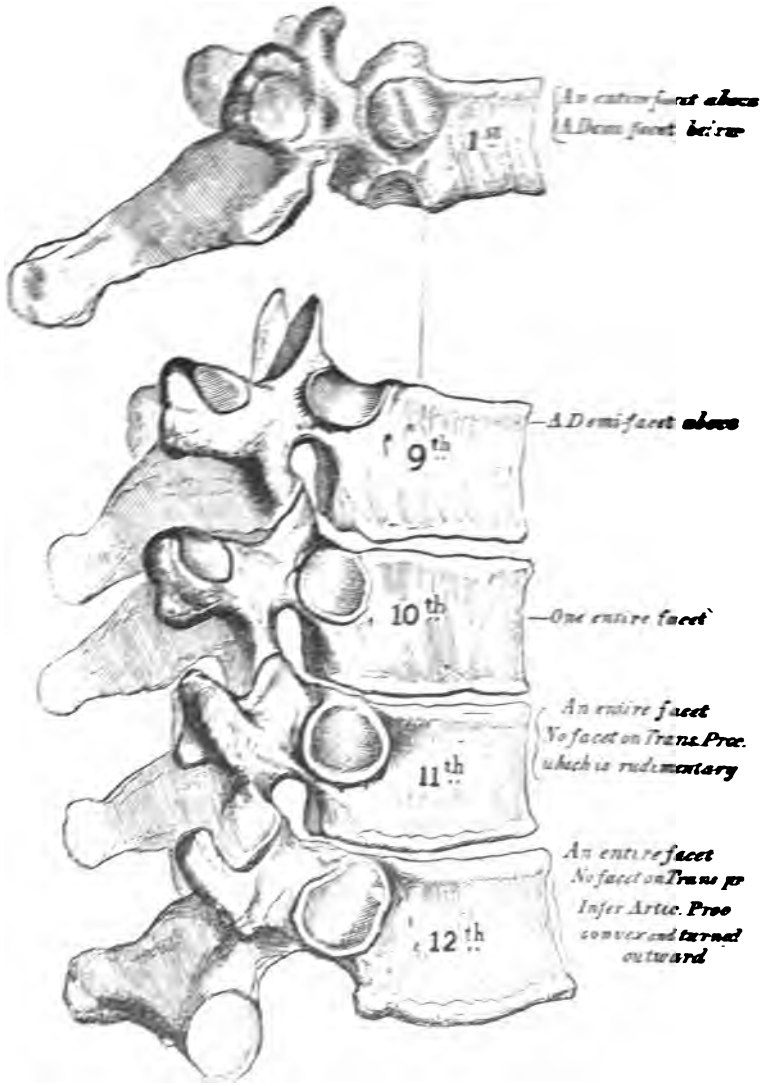


FIG. 3.—PECULIAR DORSAL VERTEBRÆ. (Gray.)

PECULIAR VERTEBRÆ

Are the:

Atlas } Vide following Tablet.
Axis }

(Vertebral artery begins ascend
6th - ant. tubercle of transverse Process is large (carotid tube

7th Cervical Vertebra, or Vertebra Prominens

Spinous process thick, long, prominent, nealy horizontal; ends in a singl
cle for ligamentum

Transverse process large, but slightly grooved, seldom bifid. Its for
usually small, sometimes wanting, and seldom gives passage
artery

1st Dorsal Vertebra

Body broad from side to side and lipped superiorly & behind; presents a c
facet above for head of 1st rib, and a demi-facet below for upper
head of

spinous process thick & but slightly inclined.

Articular processes somewhat oblique, as in the cervical vertebræ.

9th Dorsal Vertebra

Usually no inferior demi-facet.

10th Dorsal Vertebra

But one costal facet (the superior), which is usually complete.

11th Dorsal Vertebra

But one costal facet, which is always complete.

Transverse processes short, and without articular facets.

12th Dorsal Vertebra

But one costal facet, which is always complete.

Transverse processes short, and without articular facets.

Inferior articular facets, convex and looking forwards & outwards like th
lumbar ve

5th Lumbar Vertebra

Body much thicker in front than behind.

Spinous process small.

Inferior articular processes, farther apart than superior.

Transverse processes, large, thick, slightly inclined upwards.

ATLAS & AXIS.

THE ATLAS

Presents anterior & posterior arches, foramen, and lateral masses.

ANTERIOR ARCH — Presents:

ANTERIOR SURF. – Convex, in centre of which is a *tubercle* for superior oblique portion of longus colli, and for superficial anterior occipito-atloid & superficial anterior atlo-axoid ligaments.

POSTERIOR SURF. – Concave, in centre of which is an *oval facet*, which articulates with odontoid process of axis.

UPPER & LOWER BORDERS – For deep anterior occipito-atloid & deep anterior atlo-axoid ligaments.

POSTERIOR ARCH — Presents just behind the lateral masses the *Grooves* representing the *superior & inferior intervertebral notches.* – The superior grooves, which are the deepest and are sometimes converted into complete foramina, transmit the vertebral artery & the suboccipital nerve.

The posterior arch then becomes rounded, and is rough above & below for the posterior occipito-atloid & posterior atlo-axoid ligaments. It ends posteriorly in a *tubercle* for rectus capitis posticus minor.

FORAMEN — Large, and divided by transverse ligament (transverse portion of crucial ligament) into a posterior part, the largest, for spinal cord & its membranes, and an anterior part, the smallest, which receives the odontoid process of the axis.

LATERAL MASSES — Short & thick columns of bone, which present internally, externally, above & below, a *tubercle* for the transverse ligament;

Transverse Process – Large, not bifid nor grooved superiorly, perforated at its base by a very large foramen;

Sup. Articular Surf. – Large, oval, concave, converging towards its fellow anteriorly, and looking upwards, inwards & slightly backwards.

Inf. Articular Surf. – Rather smaller, flat, circular, and looking downwards & inwards.

THE AXIS

Presents the following ~~particularities~~ particulars:

Body – A good deal thicker in front than behind. It presents anteriorly a *median ridge & two lateral depressions* for part of internal or vertical portion of longus colli, and is surmounted by the

ODONTOID PROCESS – Tooth-like, presenting:

Apex – For median or suspensory occipito-odontoid ligament, and, laterally, for lateral occipito-odontoid, or check ligaments.

Body – Articular in front & behind for anterior arch of atlas & transverse ligament.

Neck – Constricted, and bound down by transverse ligament.

Pedicles – Strong & thick, lie beneath the superior articular surface, and are but very slightly grooved superiorly.

Notches – The superior are very shallow, and lie behind the superior articular surfaces: the inferior ones are much deeper and lie in front of the corresponding articular surfaces.

Laminæ – Thick & strong.

Foramen – Large, but smaller than that of atlas.

Spinous Process – Thick, bifid, deeply grooved inferiorly.

Transverse Processes – Small, pointed; foramen oblique upwards & outwards.

Articular Surfaces:

Superior – Rest upon the body, pedicles & transverse processes in front of the notches, and are large, flat, circular, and look upwards & outwards.

Inferior – Smaller, look downwards & forwards, and are similar to those of the other cervical vertebræ.

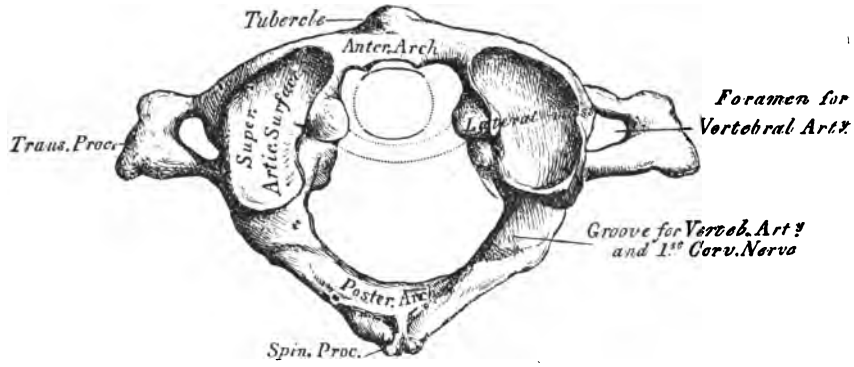


FIG. 9.—THE ATLAS. (Gray.)

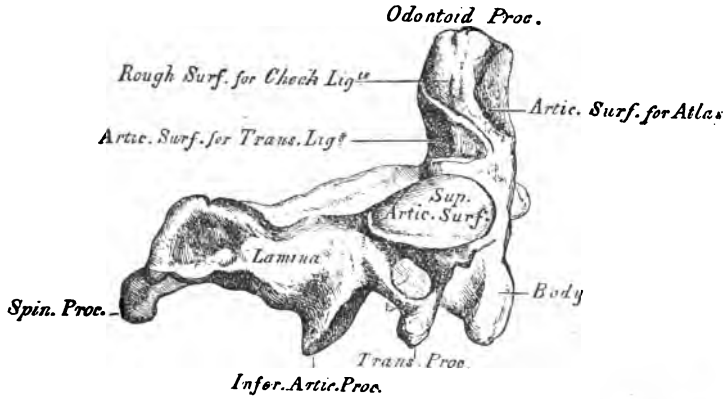


FIG. 10.—THE AXIS. (Gray.)

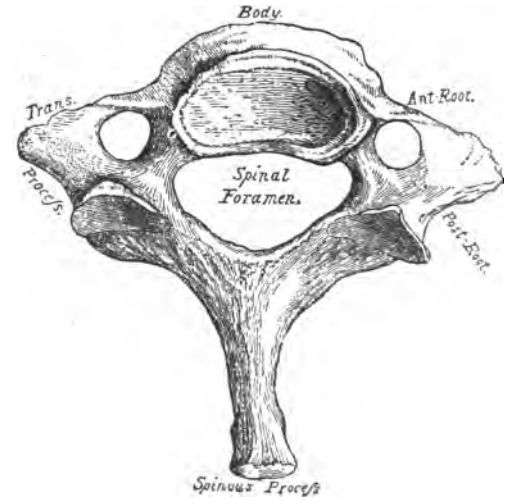


FIG 11.—THE SEVENTH CERVICAL VERTEBRA. (Gray.)

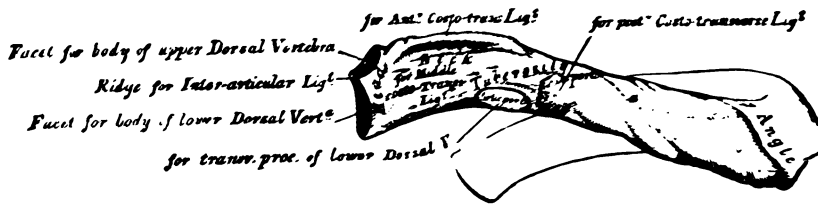

for Ant.r Costo-trans.e Lig.t
for post.r Costo-transverse Lig.t
Facet for body of upper Dorsal Vertebra
Ridge for Inter-articular Lig.t
Facet for body of lower Dorsal Vert.e
for transv. proc. of lower Dorsal V
Angle

FIG. 12.—VERTEBRAL EXTREMITY OF A RIB. OUTER SURFACE. (Gray.)

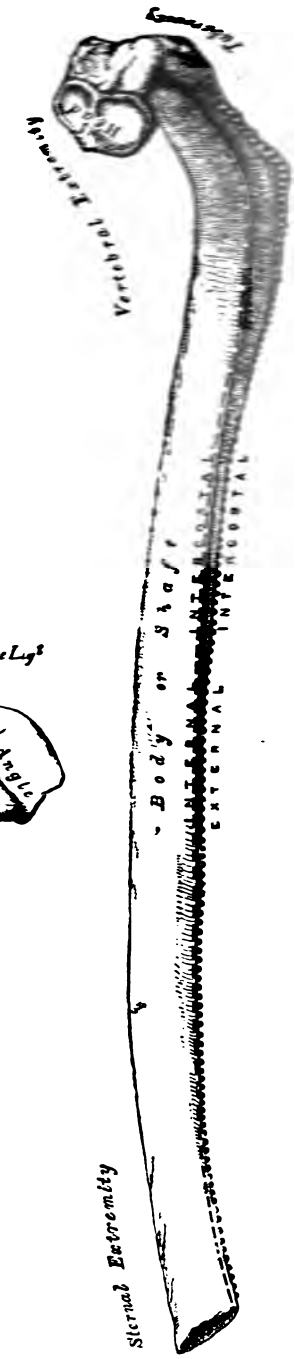


FIG. 13.—A CENTRAL RIB OF THE RIGHT SIDE. (Gray.)

HE RIBS.

Twelve.

Seven Sternal or True – Connected to the sternum by their costal
ages; these increase in length from above down
Five False or Asternal – Of which the three first are connected by th
tilages to the cartilage of the rib above, while the two
floating ribs, are entirely disconnected in front. The aste
false ribs decrease in length from above downwards.
The *breadth* of the ribs decreases from the 1st to th
so does also the width of the corresponding intercostal
The *degree of obliquity* of the ribs increases from
to the 9th, and decreases from the 9th to the 12th.
most marked between the head & the posterior angle.
The ribs are both *curved* & *twisted* upon them
The curve of the ribs is most marked in the neighbo
of the posterior angle. The twist is such that the out
face of the shaft looks slightly downwards behind & s
upwards in front, and that, if the lower border of th
be placed upon a flat horizontal surface from the a
extremity of the bone to the posterior angle, the part
bone behind the angle, will be found to pass upward

COMMON CHARACTERS — A rib presents two extremities & a shaft.

POSTERIOR EXTREMITY · Presents head, neck & tuberosity.

HEAD – Presents:
two oblique facets, a small superior one & a larger inferior one,
facets articulate with the bodies of two adjoining ver
and are separate
horizontal ridge, to which the interarticular ligament is atta

NECK – Flattened from before backwards, about an inch in length; pres
Anterior Surf. – Smooth, continuous with inner surface of the sha
Posterior Surf. – Rough for interosseous costo-transverse ligamen
Upper Border – Has a rough crest, for superior costo-transverse lig
Lower Border – More or less rounded.

TUBEROSITY – Most prominent in the upper ribs. Presents:
Inferior Internal, or Articular Portion – Has a facet for the extrer
the tranverse process of the inferior of the two vertebr
which the head is con
Superior External, or Non-articular Portion – Rough for external
transverse lig

SHAFT — Thin & flat. Presents:

OUTER SURFACE – Convex, on which is found posteriorly the
Angle, or Posterior Angle – A rough line oblique downwards & for
which gives attachment to the tendons of the sacro-lu
its accessory muscle, & the cervicalis ascendens, and
sepa
posterior rounded portion, giving attachment to the longissimu
and increasing in length from the 2nd rib to the 10th,
anterior flattened portion, smooth, looking slightly downwards
& slightly upwards in front, which presents anterio
Anterior Angle – Similar to the posterior but more faintly marked

INNER SURFACE – Concave, looks slightly upwards behind & slightly
wards in front, and presents infer
ridge extending over the posterior two-thirds of the shaft,
marked behind, which ridge gives attachment to the i
intercostal muscles, and forms the inner boundary
Groove – For the intercostal vessels & nerves, which groove is dee
most marked just in front of the

UPPER BORDER – Rounded; gives attachment to both internal & externa
costal m

LOWER BORDER – Thin & sharp. Forms outer boundary, of foregoing
and gives attachment to corresponding external inte

ANTERIOR EXTREMITY — Compressed from before backwards, prese

deep oval pit, ~~studied~~ with vascular foramina into which
corresponding costal cartilage is re

1st & 2nd ribs have no ridge
1st – 10th – 11th & 12th – have only one facet.

PECULIAR RIBS.

Are the:

First Rib – Broad, flat, horizontal, the most curved, and usually the shortest. Its
SURFACES – Look upwards & downwards.
Upper Surface – Presents posteriorly a
rough impression for scalenus medius, and anteriorly a slightly marked *tubercle* most prominent internally, for scalenus anticus, which tubercle separates
two shallow grooves, the anterior one for the subclavian vein, the posterior one for the subclavian artery.
Under Surface – Has no ridge nor groove.
BORDERS – Are turned inwards & outwards.
Inner Border – Concave, thin; presents inner part of tubercle for scalenus anticus.
Outer Border – Convex & rounded.
HEAD – Small, rounded, with a single facet for 1st dorsal vertebra.
NECK – Short & rounded.
TUBEROSITY – Large, prominent, situated on outer border.
ANGLE – Blended with tuberosity.
ANTERIOR EXTREMITY – Large & thick.

Second Rib – Is longer, less curved, only slightly oblique, and scarcely twisted.
SURFACES – Look slightly outwards & inwards.
Outer or Upper Surface – Rough & prominent towards its middle for second & third digitations of serratus magnus; rough posteriorly for scalenus posticus.
Inner or Under Surface – Has but a short & slightly marked groove.
TUBEROSITY & ANGLE – Close together; the latter slightly marked.

Tenth Rib
HEAD – Has usually but a single articular facet.

Eleventh Rib
HEAD – But a single articular facet.
No NECK.
No TUBEROSITY.

Twelth Rib
HEAD – But a single anterior facet.
No NECK.
No TUBEROSITY.
No ANGLE.
No GROOVE.

The two last ribs are but slightly curved, and are short & pointed, the twelfth rib being sometimes the shortest of all.

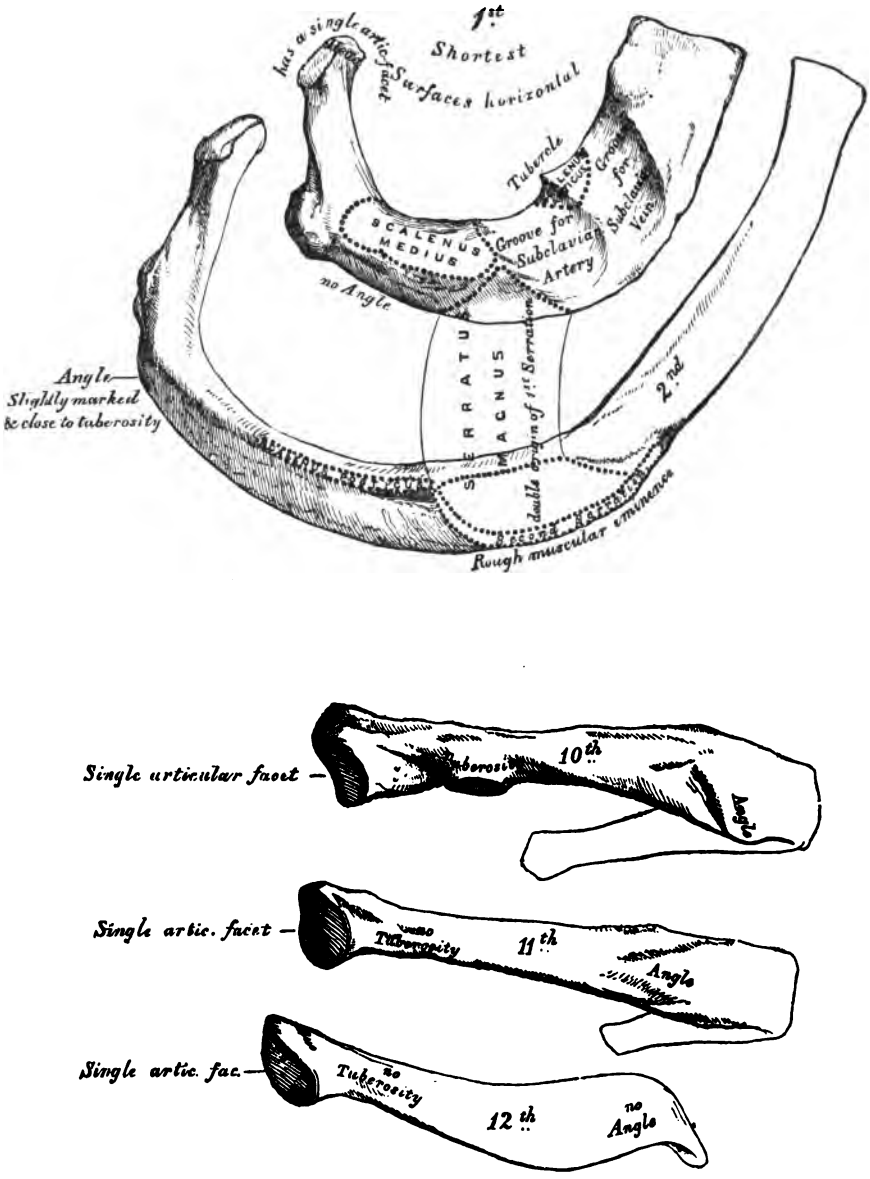


FIG 14.—PECULIAR RIBS. (Gray.)

THE SACRUM.

Consists of five vertebræ blended together, sometimes of six, occasionally of four.
Broad, thick, triangular, slightly curved, inclined downwards & backwards from *promontory*; broadest, least curved & most oblique in female. Presents: –

ANTERIOR SURFACE — Concave from above downwards along whole or part of its extent, slightly concave from side to side. Presents from the middle line outwards: –

Bodies of the Five Vertebræ separated by **Four Ridges.** – The bodies are flattened, and they diminish in size from above downwards. The ridges, which mark the original separations between them, lead laterally to the

Four Anterior Sacral Foramina. – These look forwards & outwards, diminish in size from above downwards, and are prolonged externally into

Four Broad & Shallow Grooves, – Which grooves give attachment to the pyriformis muscle, as do also the

Three Prominent Ridges, – Which separate them from each other.

These grooves & these latter ridges lie upon a portion of the bone sometimes called the *lateral mass*, which portion is formed by the blending of what are sometimes called the *anterior transverse processes*; these *anterior transverse processes* corresponding to the lumbar transverse processes & also to the external tubercles of the inferior dorsal transverse processes.

POSTERIOR SURFACE — Narrower, convex, uneven. Presents from the middle line outwards: –

Three or Four Tubercles – Corresponding to the three or four upper sacral spinous processes (the lower ones remaining undeveloped), which tubercles are usually more or less blended into one prominent median ridge.

A Longitudinal Groove – Corresponding to the laminæ. – These laminæ are broad & well developed superiorly, but they are nearly undeveloped inferiorly, where they merely assist in forming the lateral boundary of the inferior aperture of the sacral canal.

A Series of somewhat Indistinct Tubercles – Corresponding to the articular processes. The two lower tubercles blend together, and form, on either side of the inferior aperture of the sacral canal, the *sacral cornua*, which cornua articulate with the cornua of the coccyx.

Four Posterior Sacral Foramina – Smaller & less regular than the anterior ones.

A Series of Eminences – Which are sometimes called the *posterior transverse processes*, and which correspond to the accessory tubercles on the back of the lumbar transverse processes & to the inferior tubercles on the back of the few lower dorsal transverse processes. – Between these latter eminences & the median tubercles is comprised the *sacral groove* for origin of erector spinæ.

LATERAL SURFACES — Broad above, where they present anteriorly the

Auricular Surface – Ear-shaped, covered with cartilage for articulation with ilium, – and posteriorly

Several Deep & Rough Impressions – For posterior sacro-iliac ligaments. – Inferiorly the lateral surfaces become contracted into a

Thin Border – For sacro-sciatic ligaments & gluteus maximus muscle. This border, after presenting the prominent

Inferior Lateral Angle, – Is depressed into a

Deep Notch – For anterior division of 5th sacral nerve, which notch is further deepened by the vicinity of the transverse process of the first piece of the coccyx, and is even transformed sometimes into a complete foramen by the articulation of this transverse process with the border of the sacrum.

BASE — Broad & expanded, and looks upwards & forwards. Presents the body, pedicles, notches, laminæ, foramen, spinous, anterior & posterior transverse, & articular processes of the first sacral vertebra: –

Body – Forms part of promontory or sacro-vertebral angle.

Foramen – Large, triangular; forms superior aperture of sacral canal.

Anterior Transverse Processes – Expanded into a broad flat triangular surface continuous with iliac fossa.

Posterior Transverse Processes – Form two pointed eminences on the outer side of the articular processes.

Articular Processes – Similar to the superior articular processes of the lumbar vertebræ, but farther apart.

APEX — Curves downwards & forwards, and presents the small oval under surface of body of last sacral vertebra, which under surface articulates with corresponding part of first piece of coccyx.

SACRAL CANAL — Large & triangular above, small & flattened below, where its posterior wall is rendered incomplete by the non-development of the spines & laminæ of the one or two last sacral vertebræ. Into it open laterally both the anterior & the posterior sacral foramina.

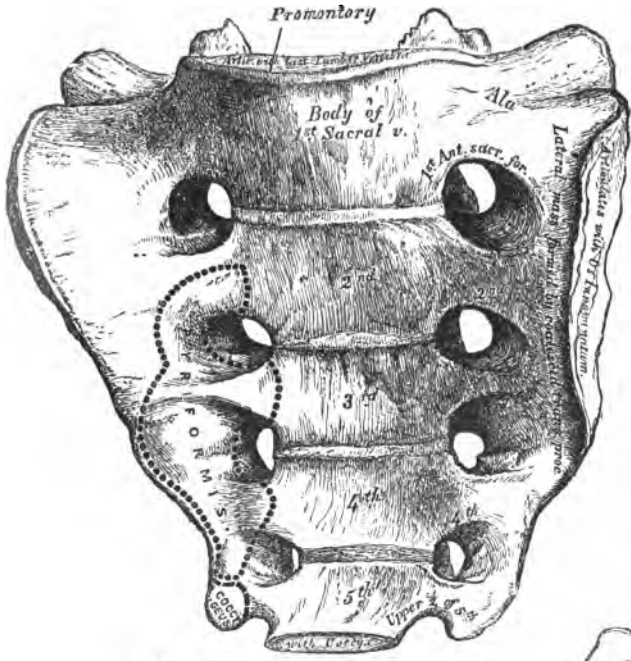


FIG. 15.—THE SACRUM: ANTERIOR SURFACE. (Gray.)

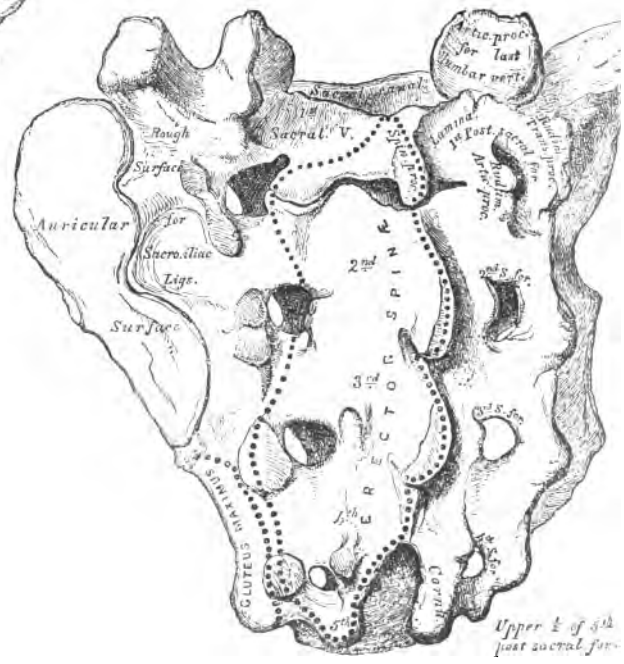
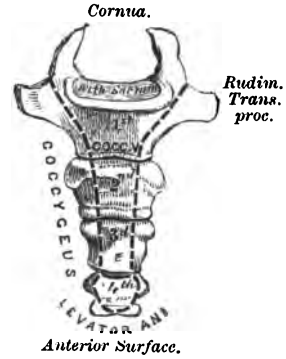
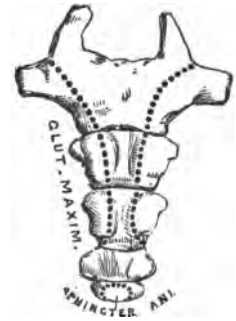


FIG. 16.—THE SACRUM: POSTERIOR SURFACE. (Gray.)

FIG. 17.—VERTICAL SECTION THROUGH THE SACRUM. (Gray.)



Anterior Surface.



Posterior Surface.

FIG. 18.—THE COCCYX. (Gray.)

THE COCCYX

Consists of four, sometimes of five, occasionally only of three vertebræ, which vertebr both incomplete and more or less rudimentary: – *incomplete*, for they are all def in pedicles, laminæ & spinous processes, and consequently also in spinal canal & i vertebral foramina: – *more or less rudimentary*, for the transverse & articular proc are distinguishable only in the first two or three vertebræ; the one or two last v bræ are therefore reduced to mere nodules of bone.

The First Coccygeal Vertebra is the largest & broadest. It articulates a with the last sacral vertebra by means of the oval & concave upper surface of its Its transverse processes project outwards, deepening the notch for the anterior div of the 5th sacral nerve, sometimes even transforming that notch into a complete for by curving upwards and articulating with the lateral margin of the sacrum. superior articular processes are prolonged upwards into the *cornua*, which co articulate with the cornua of the sacrum.

The Three Lower Coccygeal Vertebræ diminish in size from above d wards. They are usually joined to each other in the adult, the primitive lin separation between them being marked by slight transverse furrows; but up t middle period of life the second coccygeal vertebra is frequently found sepa from the first one.

At a more advanced age *all the four* bones become fused into one, which, still later period, especially in the male, is frequently joined to the sacrum.

The coccyx gives attachment to the coccygeus, gluteus maximus, levator external sphincter muscles, and to the greater & lesser sacro-sciatic ligaments.

THE SPINE in GENERAL.

The spine consists of 33 vertebræ, *i.e.*, 7 cervical, 12 dorsal, 5 lumbar, 5 sacral, 4 coccygeal.
Its average length, measured along its anterior aspect, is about 28 inches.
It presents the four following curves:

CERVICAL – Convex anteriorly; from odontoid process to 2nd dorsal.
DORSAL – Concave anteriorly; from 2nd to 12th dorsal.
LUMBAR – Convex anteriorly; from 12th dorsal to sacro-vertebral angle.
PELVIC – Concave anteriorly; from sacro-vertebral angle to tip of coccyx.

In the dorsal region it usually presents also a slight lateral curve convex to the right, probably due to muscular action.
Its anterior, lateral, & posterior aspects, and the vertebral canal, present the following points of interest: –

ANTERIOR ASPECT — The pillar formed by the superposition of the bodies of the vertebræ may be divided with respect to the width of the bodies into the four following pyramids:

CERVICAL PYRAMID – Broadest below; from odontoid process of axis to 1st cervical.
SUPERIOR DORSAL PYRAMID – Broadest above; from 1st to 4th dorsal.
DORSO-LUMBAR PYRAMID – Broadest below; from 4th dorsal to last lumbar.
SACRO-COCCYGEAL PYRAMID – Broadest above; from base of sacrum to tip of coccyx.

LATERAL ASPECT — The antero-posterior diameter of the bodies increases steadily from above downwards as far as the last lumbar vertebra; it then diminishes rapidly. – The demi-facets for the ribs are seen in the dorsal region.

The pedicles are concealed in the neck by the transverse processes.

The intervertebral foramina increase in size from above downwards, and lie, in the cervical region, *between the transverse processes*, in the dorsal & lumbar regions, *in front of the transverse processes.*

The transverse processes lie, in the cervical region, *on the outer side of the pedicles & in front of the articular processes;* in the dorsal region, *behind the pedicles & behind the articular processes;* in the lumbar region, *behind the pedicles but in front of the transverse processes.* – In the dorsal region, the transverse processes, on account of their being inclined backwards, describe a greater curve than do the bodies.

The spinous processes, on the contrary, describe a lesser curve on account of their inclination downwards.

POSTERIOR APECT — The *spines*, though they normally occupy the median line, are sometimes deviated slightly to one side or to the other independently of disease.

The vertebral groove is *broad & shallow* in the cervical region, *narrow & deep* in the dorsal region, *narrow but rather shallow* in the lumbar region.

The distance between the laminæ is greatest in the lumbar region, least in the middle part of the dorsal.

The width between the extremities of the transverse processes is great in the atlas, but much smaller in the axis; this width increases from above downwards in the cervical region, diminishes in the dorsal region, again increases in the lumbar; it suddenly becomes very great opposite the base of the sacrum, and then diminishes rapidly throughout the sacro-coccygeal region.

VERTEBRAL CANAL — Follows the curves of the spine. It is broad & triangular in the cervical region, small & circular in the dorsal, triangular & intermediate in size in the lumbar. In the sacral region it is pretty large & triangular above, smaller & flattened from before backwards towards middle, deficient in its posterior wall below.

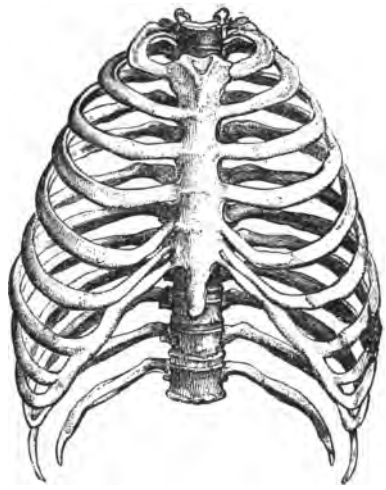


FIG. 19.—THE THORAX FROM IN FRONT. (Sappey.)

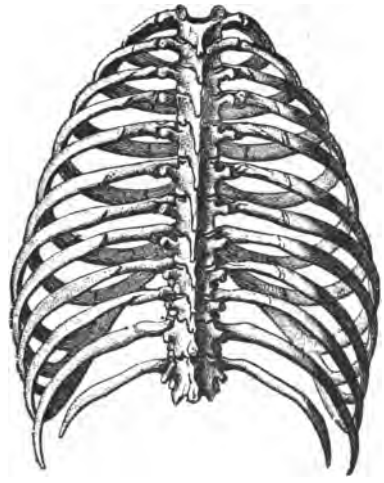


FIG. 20.—THE THORAX FROM BEHIND. (Sappey.)

FIG. 21.—LATERAL VIEW OF THE SPINE. (Gray.)

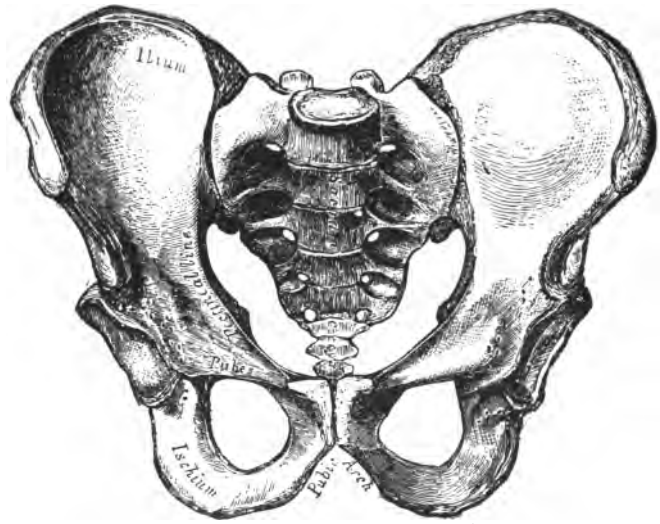


FIG 22.—THE MALE PELVIS. (Gray.)

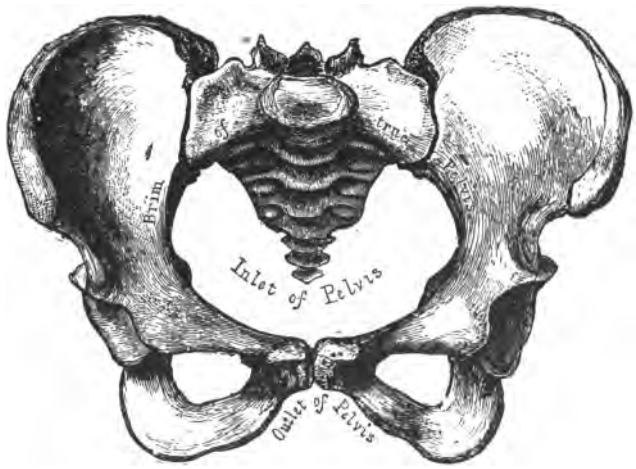


FIG. 23.—THE FEMALE PELVIS. (Gray)

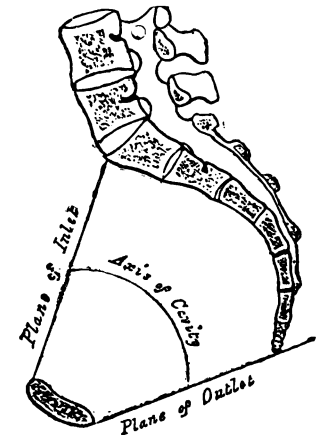


FIG. 24.—VERTICAL SECTION THROUGH THE PELVIS WITH LINES INDICATING THE AXIS. (Gray.)

THE PELVIS.

Bony ring formed by the innominate bones, sacrum & coccyx, and divided into: -

FALSE PELVIS — The superior expanded portion corresponding to the iliac fossæ. walls are deficient in front between the anterior borders of the ilia and the bod horizontal rami of the pubes, and deficient also behind between the posterior sup iliac spines & the sac

TRUE PELVIS — The inferior contracted portion; presents for examination: -

Superior Circumference, Brim or Inlet - Heart-shaped; bounded by cre spine of pubes, ilio-pectineal line, anterior border of base of sacrum & s vertebral angle. Looks upwards & forwards in the direction of a line d from middle of coccyx to umbilicus, and forms in the erect posture an an from 60° to 65° with the horizontal, the base of the sacrum lying about 3¾ i above upper border of the symphysis (Nägele). Its diameters are as follo

Sacro-Pubic (ant.-post.)	male, 4	inches;	female 4½	inches;		
Ilio-Iliac (transverse)	„ 4½	„	„	5½	„	
Sacro-Iliac (oblique)	„ 4¼	„	„	5	„	(Thoms Clel

Cavity - Short curved canal broadest towards middle, shallow in front (1½ to 2 i along back of symphysis pubis), deep behind (4½ to 5 inches along concav sacrum & coccyx). Each of its three diameters measures 4½ inches in the 5 or 5¼ in the female (Thomson & Clel

Lower Circumference or Outlet - Bounded by pubic arch, coccyx, & tubero of ischia. Apparently very irregular, but less so in reality, especially when sidered in connexion with parturition, for the sacro-sciatic notches are bri over in the recent state by the sacro-sciatic ligaments, and the coccyx is movable during pregnancy and is easily pressed backwards by the head o fœtus. Looks downwards & forwards in the direction of a line, which, longed upwards, would just touch the base of the sacrum; the top of the c lying, on a average, in the erect posture, from 7 to 8 lines above apex of arch (Nägele). Its diameters are as follo

Coccy-Pubic (ant.-post.)	male, 3½	inches;	female 5	inches.		
Bi-Ischiatic (transverse)	„ 3½	„	„	4½	„	(Thoms Clel

THE FEMALE PELVIS - As compared with the male pelvis, is lighter & more sle and the muscular impressions on its surface are less marked. It is broader fron to side. The ilia are more expanded, and the iliac spines more widely separ The *inlet* of the true pelvis is larger, and also more circular on account of the s vertebral angle being less prominent. The *cavity* of the true pelvis is more capa though shallower, and the spines of the ischia project less into it. The *outlet* is expanded & more dilatable, the pubic arch being wider, its edges more everted tuberosities of the ischia farther apart, and the coccyx more movable

THE STERNUM. has 10 articulations (only 2 are not articular)

Long narrow flat bone, oblique downwards & forwards, and slightly convex anteriorly from above downwards, which constitutes the anterior abutment of the clavicle & of the seven first costal cartilages. It consists originally of six segments, of which segments the four middle ones are usually joined together in the adult, while the upper one & the lower one remain distinct till a more or less advanced age is reached. This groupment of the primitive segments gives rise to the three parts of the adult bone, which parts are from above downwards the

MANUBRIUM – The thickest part, broad above, narrow below; supports the clavicle & the first costal cartilage, and partly also the second costal cartilage.

GLADIOLUS – The longest & central part, blade-like, & broadest a little below its middle; supports the third, fourth, fifth & sixth costal cartilages, and partly also the second & the seventh ones. Is sometimes perforated by the *sternal foramen*.

ENSIFORM OR XYPHOID APPENDIX – Very variable, – broad, – pointed, – perforated, – forked, – deflected to one side or other. Partly supports the cartilage of the seventh rib. – The bone presents: –

Anterior Surface – Convex from side to side & concave from above downwards in the manubrium; flat, and marked by three transverse lines in the gladiolus, which lines correspond to the points of junction of the four middle segments, and also to the points of articulation with the gladiolus of the third, fourth, & fifth costal cartilages. – Gives attachment to sternal portion of sterno-mastoid, pectoralis major, and anterior chondro-sternal & chondro-xyphoid ligaments.

Posterior Surface – Slightly concave, smoother; marked in the gladiolus by three transverse lines corresponding to, but less distinct than, those on the anterior surface. Gives attachment to sterno-hyoid & -thyroid, triangularis sterni, median fasciculus of diaphragm, and posterior chondro-sternal ligaments.

Superior Border – Thick; presents in the centre the

Interclavicular Notch, – and laterally the

Clavicular Facets – Convex from before backwards, concave from above downwards & outwards; articulate with the interarticular fibro-cartilage of the sterno-clavicular articulation.

Lateral Borders – Present seven costal articular depressions separated by six intervening scallops, which latter diminish in breadth from above downwards. The seven articular depressions are situated as follows: – the *first* one on the side of the manubrium just below the clavicular facet; the *second* one at the point of articulation between the manubrium & the gladiolus (it therefore presents two facets); the *third, fourth & fifth* ones on the sides of the gladiolus opposite the points of junction of its four primitive segments; the *sixth* one on the side of the last segment of the gladiolus; the *seventh* one at the point of articulation between the gladiolus & the ensiform appendix.

Apex – Formed by the ensiform appendix; gives attachment to linea alba, anterior abdominal aponeurosis & innermost fibres of rectus abdominis muscle.

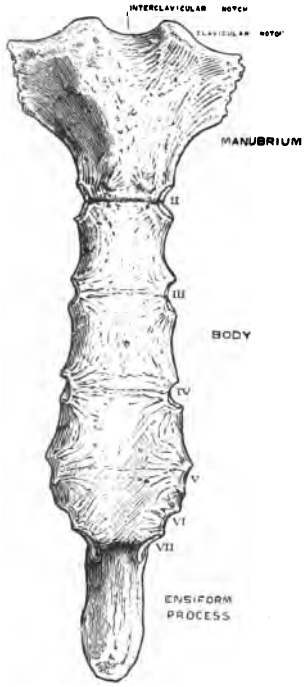


FIG. 25.—THE STERNUM, FROM BEFORE. (Quain.)

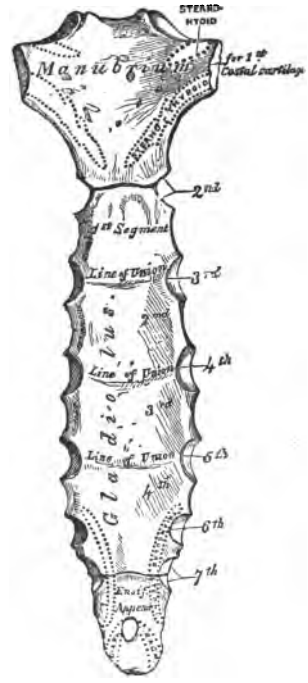


FIG. 26.—THE STERNUM, FROM BEHIND. (Gray.)

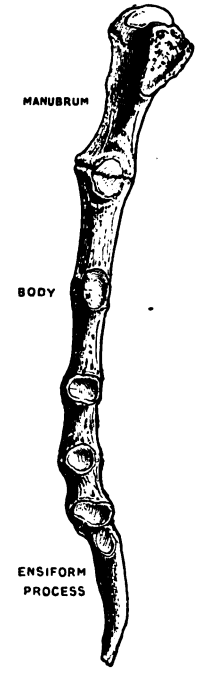


FIG. 27.—THE STERNUM, FROM THE LEFT SIDE. (Quain.)

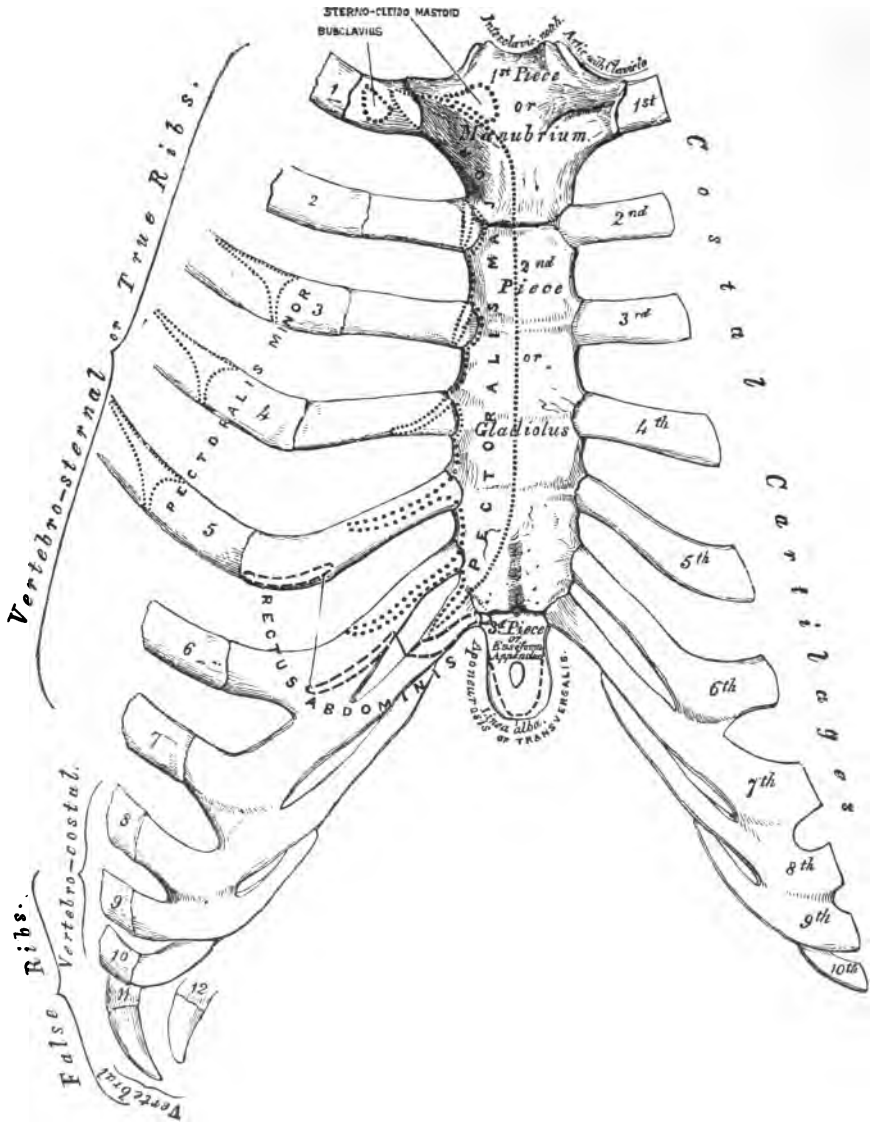


FIG. 28.—COSTAL CARTILAGES AND ANTERIOR SURFACE OF THE STERNUM. (Gray.)

THE COSTAL CARTILAGES.

Twelve. The *first seven* connect corresponding rib to sternum, the *three next* are join
cartilage of rib above, the *last two* are unattached in
In breadth, they decrease from the first to the last, as do also the intercostal spaces.
In length, they increase from the 1st to the 7th, and then diminish from the 8th to the
In direction, the *first* is slightly oblique downwards, the *second* horizontal, the *third* sli
oblique upwards; the *two last* follow the direction of the corresponding ribs; *a*
others follow this direction for a short distance, and then ascend more & more
quely to the sternum or to the preceding carti
They all *taper towards their sternal end*, excepting the two first; the sixth, seventh, eight
ninth are enlarged at their points of articulation with each o
They present: –

Anterior Surface – Convex, looks upwards & forwards, – for subclavius, pectoralis maj
rhomboid or costo-clavicular ligan

Posterior Surface – Concave, looks downwards & backwards, – for triangularis sterni, t
versalis, & diaphr

Upper Border – Concave. For intercostals. Presents the chondro-chondral interarti
facets in the 7th, 8th, & 9th cartil

Lower Border – Convex. For intercostals, internal oblique & rectus abdominis. Present
chondro-chondral interarticular facets in the 6th, 7th, & 8th cartil

Costal Extremity – The largest; rough & rounded, implanted into, & continuous with, ant
extremity of correspondin

Anterior or Sternal Extremity – The smallest. Smooth & triangular, and fits into st
articular notch, in the case of the 2nd, 3rd, 4th, 5th, 6th, & 7th cartilages; po
and joins with the cartilage above, in the case of the 8th, 9th, & 10th; point
free in the case of the 11th & 12th; enlarged and directly continuous wit
sternum in the case of th

THE THORAX in GENERAL.

Conical with convex walls and axis oblique downwards & forwards; broadest below & from side to side; bounded by dorsal portion of spine, ribs, costal cartilages & sternum. Presents for examination: -

OUTER SURFACE — Convex. Presents: -

Anterior Aspect - Oblique downwards & forwards, 8½ inches in height. Presents sternum, costal cartilages, & front part of ribs, which latter present their anterior angles disposed in a line oblique downwards & outwards.

Posterior Aspect - Twelve inches in height, depressed centrally, convex on either side. Presents: -

IN MIDDLE LINE - Spines, vertebral grooves, transverse processes, costo-transverse articulations; -

LATERALLY - Prominent convexity of posterior part of ribs, which convexity increases in breadth from above downwards, and is bounded externally by the posterior angles of the ribs disposed in a line oblique downwards & outwards.

Lateral Aspect - Oblique, rounded, thirteen inches in height, most convex posteriorly.

In length the ribs & the costal cartilages increase from the 1st to the 7th, and decrease from the 8th to the 12th; the intercostal spaces increase from the 1st to the 5th only, and then decrease from the 6th to the 11th. The *width* of the ribs & intercostal spaces decreases from the 1st to the last, the width of the latter being greatest in front. The degree of *obliquity* of the ribs increases from the 1st to the 9th, and decreases from the 9th to the 12th; it is most marked behind.

SUPERIOR APERTURE or APEX — Narrow, heart-shaped, oblique downwards & forwards, bounded by the sternum, first dorsal vertebra, first rib & first costal cartilage.

INFERIOR APERTURE or BASE — Expanded from side to side, widest towards middle, and, from before backwards, diminished behind by prominence of body of last dorsal vertebra, and greatly increased in front by being prolonged upwards & forwards between the asternal ribs & their cartilages as far as the ensiform appendix.

INTERNAL CAVITY — Broadest from side to side, narrowed from before backwards in middle line, and partly divided posteriorly into two, by the incomplete septum formed by bodies of vertebræ, on either side of which bodies it is prolonged backwards so as to form two deep grooves widest below.

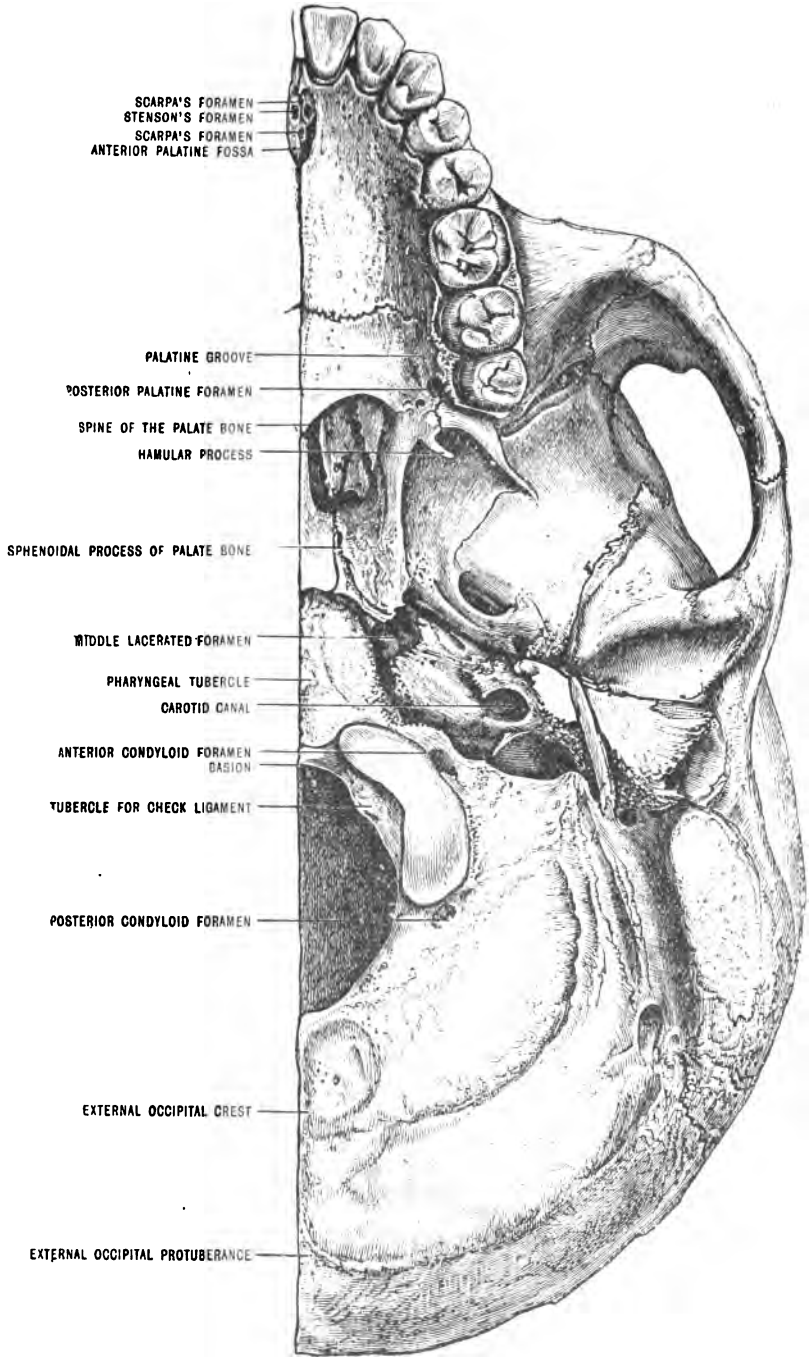


FIG. 28A.—UNDER SURFACE OF BASE OF SKULL. (Morris.)

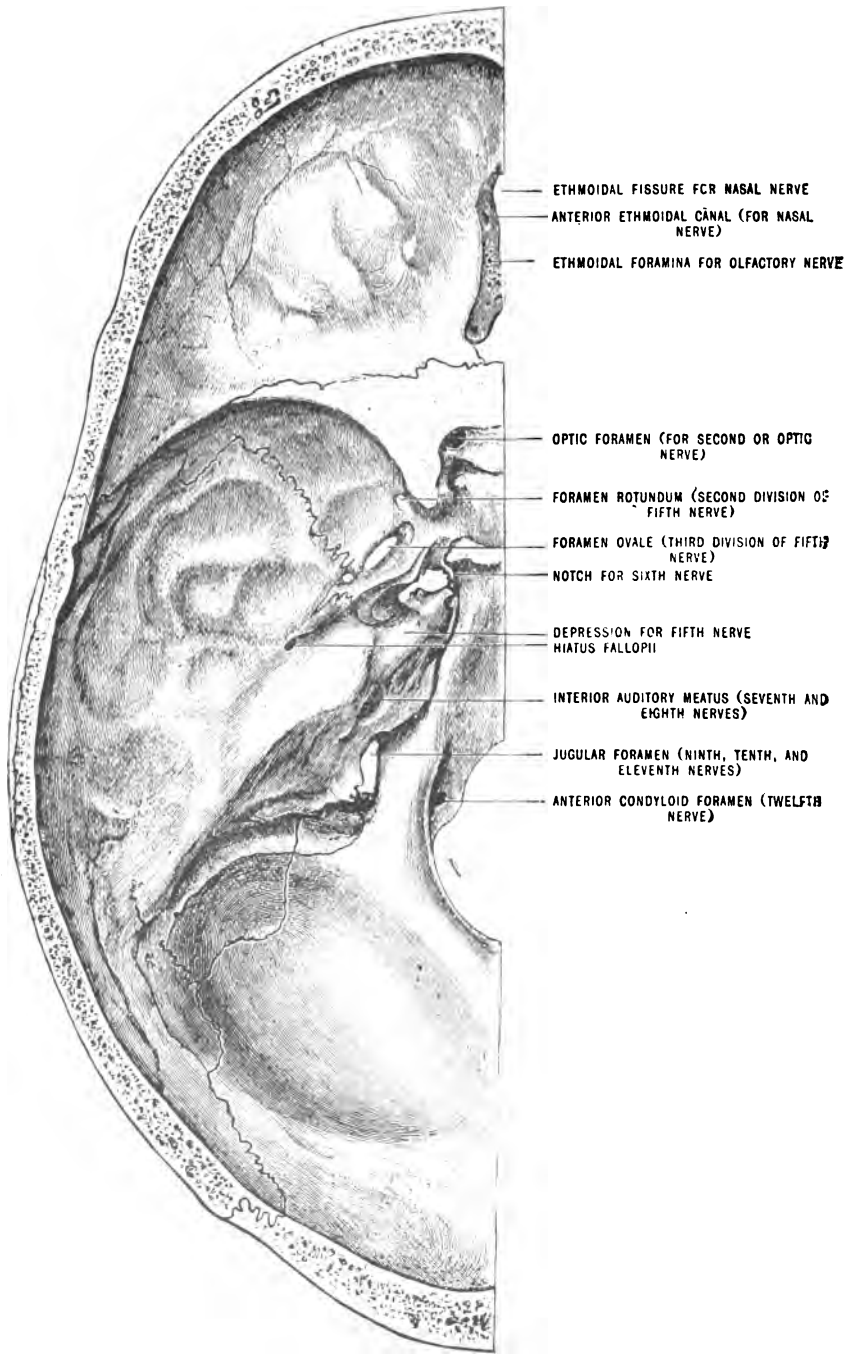

ETHMOIDAL FISSURE FOR NASAL NERVE
ANTERIOR ETHMOIDAL CANAL (FOR NASAL NERVE)
ETHMOIDAL FORAMINA FOR OLFACTORY NERVE
OPTIC FORAMEN (FOR SECOND OR OPTIC NERVE)
FORAMEN ROTUNDUM (SECOND DIVISION OF FIFTH NERVE)
FORAMEN OVALE (THIRD DIVISION OF FIFTH NERVE)
NOTCH FOR SIXTH NERVE
DEPRESSION FOR FIFTH NERVE
HIATUS FALLOPII
INTERIOR AUDITORY MEATUS (SEVENTH AND EIGHTH NERVES)
JUGULAR FORAMEN (NINTH, TENTH, AND ELEVENTH NERVES)
ANTERIOR CONDYLOID FORAMEN (TWELFTH NERVE)

FIG. 28B.—INNER SURFACE OF BASE OF SKULL. (Morris.)

The two beautiful Figures, 28A & 28B, were received too late to be inserted in their proper position. They are placed here, by the kind permission of Mr. Bland Sutton, Mr. Henry Morris, and the publishers of Morris's Anatomy.

BONES OF THE SKULL.

THE FRONTAL BONE.

Articulates with sphenoid & ethmoid, and with both parietal, nasal, superior maxillary, lachrymal & malar

Divided into vertical or frontal, and horizontal or orbito-nasal portions.

VERTICAL OR FRONTAL PORTION — Presents:

Ext. Surface – Presents in median line:

Median suture, usually obliterated a few years after birth, and below which is the

Nasal eminence, or *glabella*; – and laterally from above downwards

Frontal eminence;

Superciliary ridge caused by projection of frontal sinuses, broad inwardly where it joins the nasal eminence;

Supraorbital arch, presenting at its inner third the

Supraorbital notch or foramen, for supraorbital vessels & nerve, – and which arch terminates externally and internally in the external & internal angular processes.

EXT. ANGULAR PROCESS – Thick & strong; articulates with malar bone, and presents externally a part of the

Temporal ridge. *

INT. ANGULAR PROCESS – Thinner; articulates with lachrymal bone and bounds the

Nasal notch, which articulates with nasal bones & nasal processes of superior maxilla, and presents below the

Nasal spine.

Int. Surface – Concave. Presents in median line and from below upwards:

Foramen cæcum (completed behind by ethmoid) for small vein to longitudinal sinus and a process of falx cerebri;

Frontal crest, which is continued into

Groove for longitudinal sinus & falx cerebri; – and laterally

Cerebral impressions and

Grooves for branches of anterior & middle meningeal arteries.

HORIZONTAL OR ORBITO-NASAL PORTION — Consists of the two orbital plates separated by the ethmoidal notch.

ORBITAL PLATES — Present:

Under Surface – Concave, on which are seen externally the

Lachrymal fossa for lachrymal gland, and internally the

Fovea trochlearis for pulley of superior oblique.

Upper Surface – Convex, forms part of anterior fossa of base of skull, and presents well marked cerebral impressions.

ETHMOIDAL NOTCH – Is filled up by horizontal plate of ethmoid. – The under surface of its margin presents:

Several half-cells, which complete & close the ethmoidal cells, and

Two grooves, which form part of

Anterior ethmoidal canal for nasal n. & ant. ethmoidal vessels, and of

Posterior ethmoidal canal for posterior ethmoidal vessels.

In front of the ethmoidal notch is the

Nasal spine, which articulates with nasal bones & perpendicular plate of the ethmoid and forms part of roof of nose, and on the sides of which are the

Openings of the frontal sinuses

The circumference of the bone is thick in the vertical or frontal portion, where it is serrated for articulation with the parietals, and is bevelled at the expense of the inner table, above, of the outer table, below. In the horizontal portion the circumference is thin & serrated for articulation with the lesser wing of the sphenoid. At the junction of the two portions of the bone the circumference presents a large triangular rough surface for articulation with the greater wing of the sphenoid.

* See pp. 50 & 51; see also Fig. 75, p. 68.

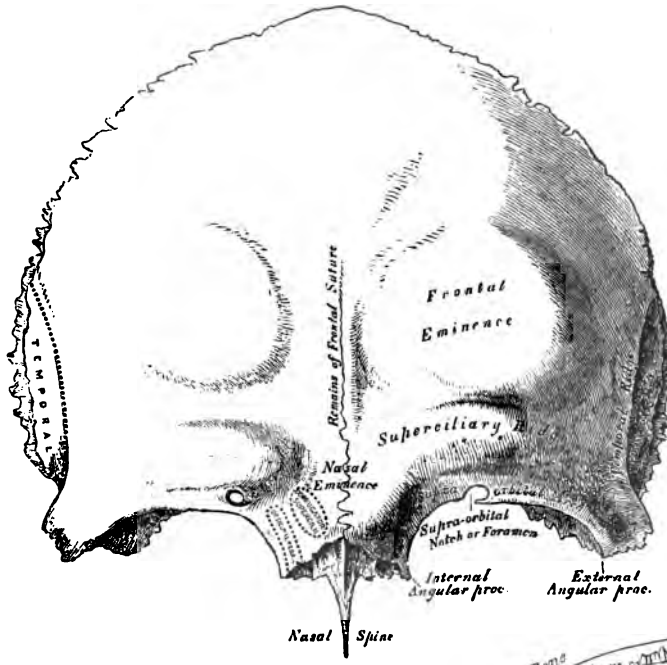


FIG. 29.—THE FRONTAL BONE OUTER SURFACE. (G

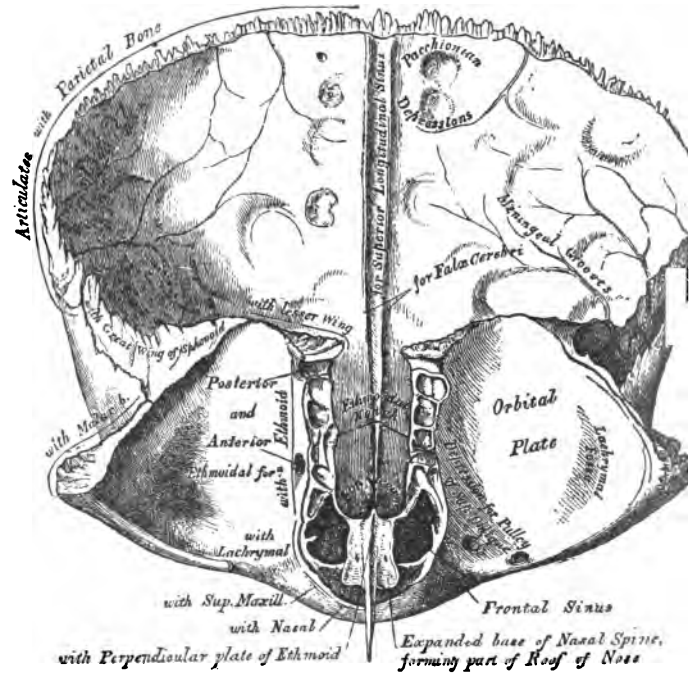

Articulates with Parietal Bone
Posterior and Anterior Ethmoidal for.
with Lachrymal
with Sup. Maxill.
with Nasal
with Perpendicular plate of Ethmoid
Orbital Plate
Frontal Sinus
Expanded base of Nasal Spine, forming part of Roof of Nose

FIG. 30.—THE FRONTAL BONE: INNER SURFACE. (Gray.)

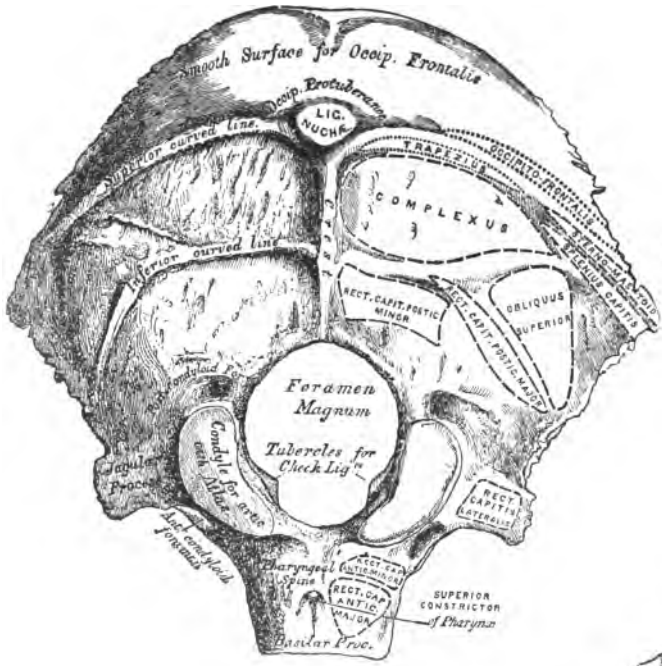


FIG. 31.—THE OCCIPITAL BONE. OUTER SURFACE. (Gray.)

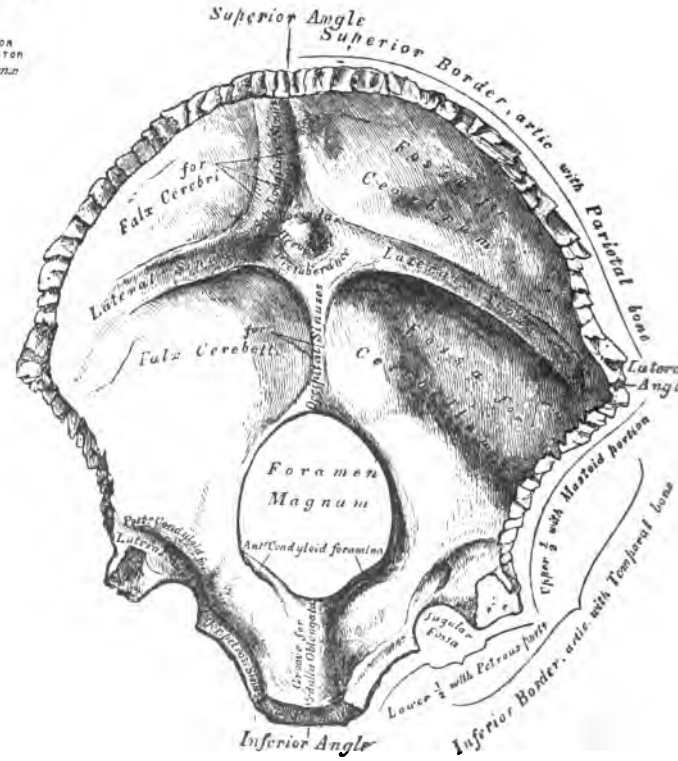


FIG. 32.—THE OCCIPITAL BONE: INNER SURFACE. (Gray.)

THE OCCIPITAL BONE.

Articulates with parietals, mastoid & petrous portions of temporals, sphenoid & atlas, presc

OUTER SURFACE — Convex. Presents from behind forwards:

Ext. occipital protuberance for ligamentum nuchæ;

Ext. occipital crest, from which are given off laterally the

* *Sup. curved line*, for trapezius, sterno-mastoid & occipito-frontalis; and

Inf. curved line for recti capitis postici major & minor which are also inse into depression below. – Between the two curved lines inserted the complexus, splenius & superior obl

Foramen magnum for cord and its membranes, spinal accessory nerves & verte arteries, on outer side of which foramen ar

Condyles, oblong, converging in front, convex from before backwards, loo downwards & outwards; rough inwardly for attachmen check ligaments, and having in

Ant. condyloid foramen for hypoglossal nerve; having behind

Post. condyloid fossa sometimes perforated by posterior condyloid men for a small vein to lateral sinus, and having on outer sid

Jugular process for rectus capitis lateralis & lateral occipito-a ligam

Basilar process presenting in middle line the

Pharyngeal spine for tendinous raphe & superior constrictor of pharynx, latera

Rough depression for recti capitis antici major & minor.

INNER SURFACE — Concave, presents from behind forwards:

Crucial ridge, to centre of which corresponds the torcular Herophili, and of whic

Upper division ascends to superior angle, and is deeply grooved for sup longitudinal sinus & falx cer

Inf. division, or int. occipital crest, descends to foramen magnum whe bifurcates; gives attachment to falx cere

Lateral divisions bound posteriorly the inferior occipital fossæ, and are d grooved for lateral sinuses & tentorium cere

Foramen magnum, near side of which are the

Ant. condyloid foramina & sometimes the

Post. condyloid foramina.

Basilar groove, which supports medulla oblongata & pons, and on each side of v is a

Groove for inferior petrosal sinus.

BORDERS — Four:

Superior – Form lambdoid suture by articulating with parietals.

Inferior – Articulate with mastoid & petrous portions of temporal, and a in forming jugular foramen or foramen lacerum post

ANGLES — Four:

Superior – Received between the two parietal bones, and correspon posterior fonta

Inferior – Joins with body of sphenoid about 18th or 20th year.

Lateral – Received between posterior inferior angle of parietal and ma portion of temporal; presents on its inner surface outer end of g for lateral s

^ See pp. 50 & 51.

THE TEMPORAL BONE.

Is situated at side of base of skull, and articulates with *parietal, occipital, sphenoid, malar & inferior maxillary bones.*

Is divided into squamous, mastoid & petrous portions.

SQUAMOUS PORTION — Presents outer & inner surfaces and circumference.

Outer Surface — Convex, forms part of temporal fossa and presents lower part of *temporal ridge* behind, *zygomatic process* in front, and *glenoid fossa* below.

ZYGOMATIC PROCESS — First projects outwards, and is broad & flattened from above downwards. It then twists forwards and presents:

BORDERS – *upper* long & thin for temporal f.; *lower* short & thick for masseter.

SURFACES – *outer* convex, *inner* concave also for masseter.

APEX – Serrated, articulates with malar bone.

BASE – Presents *three roots:**

Anterior – Wide & transversely directed forming *eminentia articularis;*

Middle, or *post-glenoid tubercle* – Forms posterior boundary of glenoid fossa;

Posterior – Forms origin of temporal ridge.

GLENOID FOSSA — Is comprised between anterior & middle roots of the zygoma, and presents the

GLASERIAN FISSURE – For processus gracilis of malleus, laxator tympani m.*, & tympanic artery, and divides the fossa into

Anterior part – Articular, and covered with cartilage which is prolonged over the eminentia articularis.

Posterior part – Non-articular, bounded behind by vaginal & auditory processes & middle root of zygoma.

Inner Surface — Concave. Presents cerebral impressions, and grooves for middle meningeal artery.

Circumference — Thin above and behind, where it is bevelled internally and articulates with parietal; thick in front, where it is slightly bevelled externally and articulates with great wing of sphenoid.

MASTOID PORTION — Presents outer & inner surfaces and borders.

Outer Surface — Rough; presents:

* *Mastoid foramen* for a vein to lateral sinus, and is prolonged into

Mastoid process for insertion of sterno-mastoid, splenius capitis & trachelo-mastoid, and on the inner side of which is the

Digastric groove for origin of posterior belly of digastric, and further inwards the

Occipital groove for occipital artery.

Inner Surface — Forms part of posterior fossa of base of skull and presents descending portion of

Groove for lateral sinus.

Borders - Post. & Sup. — Thick & serrated for posterior inferior angle of parietal and lower border of occipital.

PETROUS PORTION — Vide next Tablet.

See page 52.

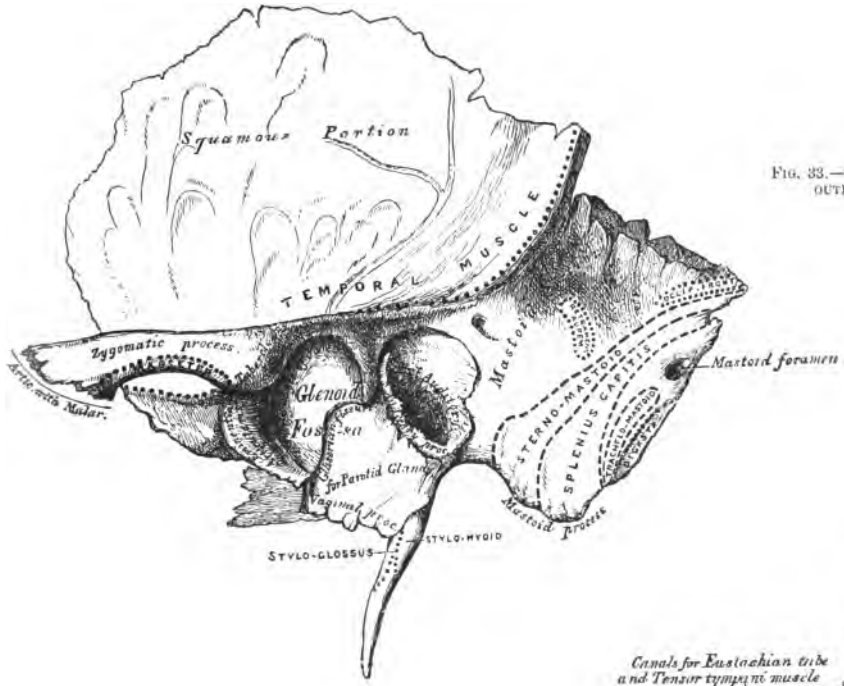


FIG. 33.—THE LEFT TEMPORAL BONE; OUTER SURFACE. (Gray.)

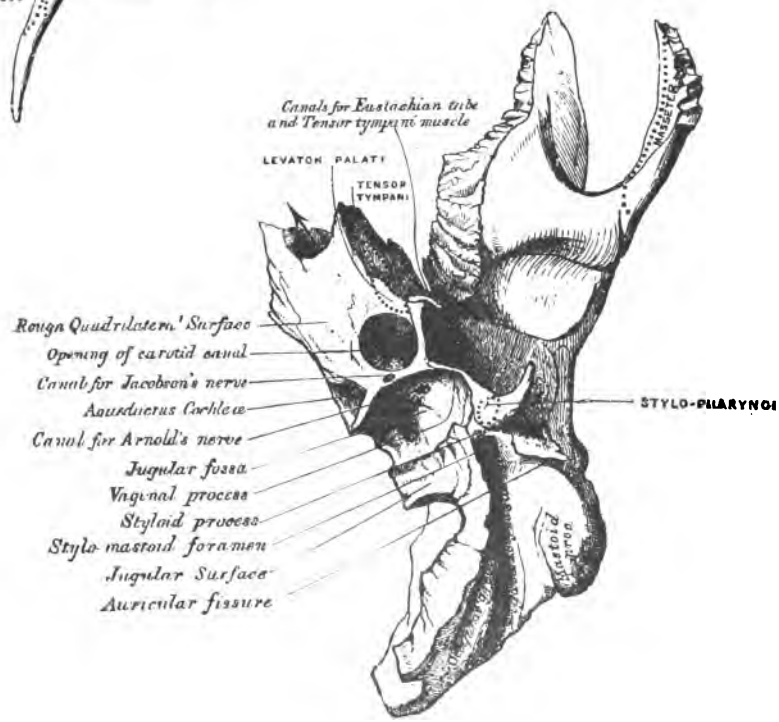


FIG. 34.—PETROUS PORTION OF THE TEMPORAL BONE: UNDER SURFACE. (Gray.)

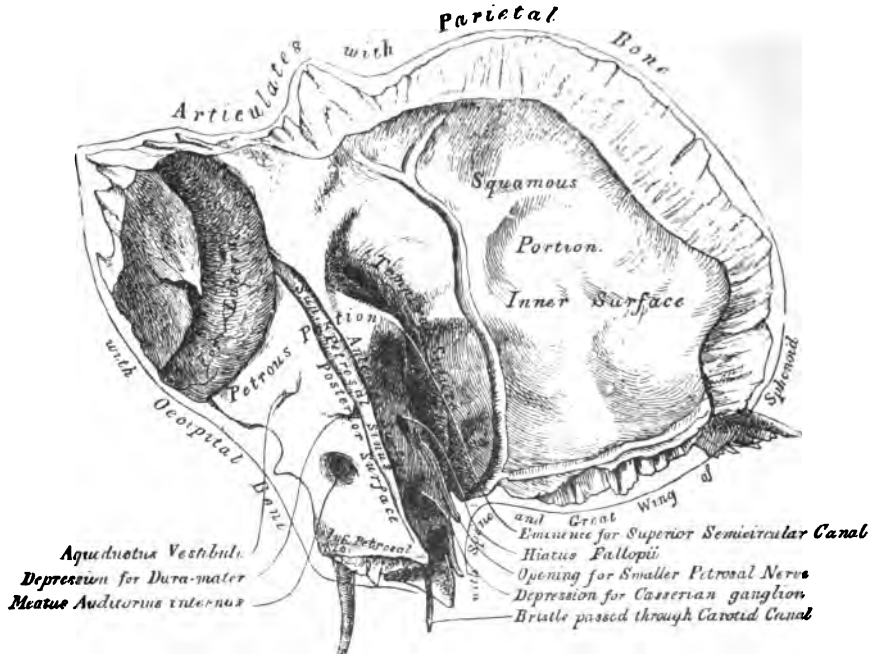


FIG. 35.—LEFT TEMPORAL BONE: INNER SURFACE. (Gray.)

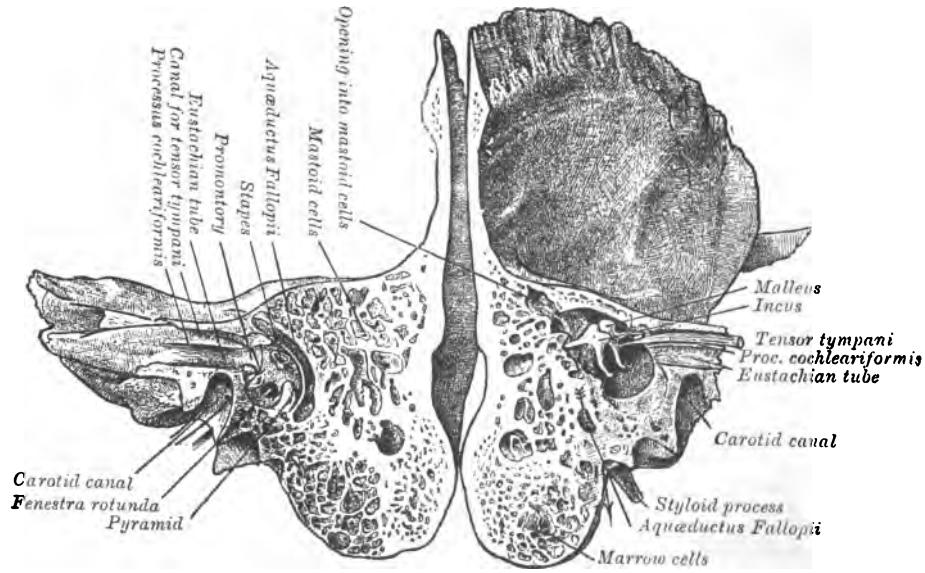


FIG. 36.—SECTIONS THROUGH THE PETROUS AND MASTOID PORTIONS OF THE TEMPORAL BONE, SHOWING THE COMMUNICATIONS OF THE CAVITY OF THE TYMPANUM WITH THE MASTOID CELLS. (Gray.)

PETROUS PORTION of the TEMPORAL BONE.

Pyramidal, directed forwards & inwards and wedged in between the sphenoid & the b
lar process of the occipital. Prese

Base — Its exposed part presents the
Meatus auditorius externus, the lower part of which is surrounded by the
Auditory process, to which is attached the cartilage of the pinna.

Apex — Presents the
Internal orifice of the carotid canal; and forms the posterior & outer boundaries of
foramen lacerum medi

Ant. Surface — Forms posterior boundary of middle fossa of base of skull, and presents f
before backwards & outwards
Internal orifice of the carotid canal,
Depression for Gasserian ganglion,
Hiatus Fallopii with *a groove leading to it*, both for large superficial petrosal nerve
petrosal branch of middle meningeal artery, and near which hi
are frequently
Two or three other small foramina for small superficial petrosal nerve, petr
branch of glosso-pharyngeal & branch of glosso-pharyngeal to l
superficial petrosal ne
Eminence corresponding to the superior semi-circular canal, on the outer side of which is
Depression corresponding to the cavity of the tympanum.

Post. Surface — Forms anterior boundary of posterior fossa of base of skull, and presents:
Meatus auditorius internus for facial nerve and auditory artery & nerve;
Opening of Aqueductus Vestibuli for small artery & vein to vestibule & a process of
dura ma

Inf. or Basilar Surface — Presents in a diagonal line from before backwards & outward
Rough surface for origin of levator palati & tensor tympani;
Inferior orifice of carotid canal;
Vaginal process which embraces root of
Styloid process, which gives attachment from above downwards to the stylo-pharyng
-hyoideus & -glossus muscles, and to the stylo-hyoid & -maxillary li
Stylo-mastoid foramen for facial nerve & stylo-mastoid artery. – Behind & on inner
of the carotid canal & vaginal process are
Jugular surface, which articulates with jugular process of occipital, and th
Jugular fossa for sinus of internal jugular vein, which fossa assists in forn
jugular foramen or foramen lacerum posterius, and has near t
Opening for Arnold's nerve, on its outer wall,
Opening for Jacobson's nerve, in front, on bony ridge between it & ca
c
Opening of Aqueductus Cochleæ, in front & to inner side, close to post
border of the petrous b

Borders — Three:
SUPERIOR – Grooved for superior petrosal sinus & attachment of tentorium cerebelli.
POSTERIOR – Grooved in front for inferior petrosal sinus; presents jugular fossa behind.
ANTERIOR – Its INNER PART articulates with spine of sphenoid; its OUTER PART is joine
a suture to the squamous portion of the bone. In the angle of junction of t
two portions are found
Canal for the tensor tympani muscle above, and the
Osseous portion of the Eustachian tube below, on the outer side of which latter opening i
Canal of Huguier for exit of chorda tympani.

THE SPHENOID BONE

Is situated at front part of base of skull, and articulates with the 7 other cranial bones & with vomer & both malar & palate bones.

Presents for examination:

BODY — Is cuboid, but presents only four free surfaces, the two lateral surfaces being continuous with the wings & pterygoid processes.

UPPER SURFACE — Presents from before backwards:
Ethmoidal spine, which articulates with ethmoid;
Smooth surface slightly elevated in median line, and which supports olfactory nerves;
Optic groove leading laterally to optic foramen;
Olivary process;
Pituitary fossa or sella turcica bounded laterally & in front by middle clinoid processes;
Dorsum sellæ notched laterally for 6th pair of cranial nerves, and presenting posterior clinoid processes at its superior angles. On each side of body is the
Cavernous groove curved like an italic *S* for internal carotid artery.*

ANTERIOR SURFACE — Presents in middle line the
Sphenoidal crest, which articulates with perpendicular plate of ethmoid; on either side the
Openings of the sphenoidal sinuses, which are partly closed in front by the
Sphenoidal turbinated bones or bones of Bertin. — This surf. articulates laterally with os planum of ethmoid, and inferiorly with orbital process of palate bone.

UNDER SURFACE — Presents in middle line the
Rostrum, which is received between the alæ of the vomer, and is continuous anteriorly with sphenoidal crest; on each side of the rostrum is the
Vaginal process, which passes inwards beneath, and articulates with, the alæ of the vomer, and externally to which is the
Pterygo-palatine groove, which forms pterygo-palatine canal with sphenoidal process of palate bone.

POSTERIOR SURFACE — Articulates with basilar process of occipital bone, with which it unites at age of 18 or 20.

GREATER WINGS — Present:

SUPERIOR or CEREBRAL SURFACE — Forms part of middle fossa of base of skull, and presents from before backwards at its inner part:
Foramen rotundum for superior maxillary nerve;
Foramen ovale for inferior maxillary & small petrosal nerves & small meningeal artery, on the inner side of which latter foramen is sometimes seen the
Foramen Vesalii for a small vein;
Foramen spinosum for middle meningeal artery.

EXTERNAL SURFACE — Is divided by pterygoid ridge into:
Superior part, which enters into formation of temporal fossa, and
Inferior part, which assists in forming zygomatic fossa, and presents posteriorly
Spine of sphenoid for internal lateral ligament of jaw & laxator tympani muscle.

ANTERIOR or ORBITAL SURFACE — Quadrilateral; assists in forming outer wall of orbit and sphenoidal & spheno-maxillary fissures, and articulates with frontal & malar bones. Presents a small spine for lower head of external rectus.

CIRCUMFERENCE.
From Back of Body to Spine – Forms anterior or outer margin of foramen lacerum medium, in front, and articulates, behind, with petrous portion of temporal b.
From Spine to Tip – Articulates with squamous portion of temporal bone, being bevelled internally below, externally above.
From Tip to Front of Body – Presents externally a broad triangular surface for frontal bone, and forms, internally, lower boundary of sphenoidal fissure.

LESSER WINGS or PROCESSES of INGRASSIAS — Long, thin, triangular:

UPPER SURFACE — Smooth, forms part of anterior fossa of base of skull;

UNDER SURFACE — Forms back of roof of orbit and upper boundary of sphenoidal fissure, which latter is bounded internally by body of sphenoid, and transmits 3rd, 4th & 6th nerves, and ophthalmic nerve & vein.

ANTERIOR BORDER — Articulates with frontal bone;

POSTERIOR BORDER — Forms at its inner extremity the anterior clinoid process.

INNER EXTREMITY — Presents two roots which bound optic foramen.

PTERYGOID PROCESS — Consists of two plates which bound pterygoid fossa, and are separated below by a triangular notch filled up by pterygoid process of palate bone. – Its

ANTERIOR SURFACE — Forms posterior wall of spheno-maxillary fossa, and presents anterior orifice of vidian canal.

EXTERNAL PTERYGOID PLATE — Broad, thin, inclined outwards. Forms inner & outer walls of zygomatic & pterygoid fossæ respectively, and gives attachment to internal & external pterygoid muscles.

INTERNAL PTERYGOID PLATE — Narrower & longer. Its
Outer & inner surfaces – Form respectively inner boundary of pterygoid fossa & outer boundary of posterior nares. At its apex it presents
Hamular process for reflection of tendon of tensor palati, and at its base
Scaphoid fossa for origin of that muscle.

* See pp. 51 & 52; see Fig. 76, p. 68.

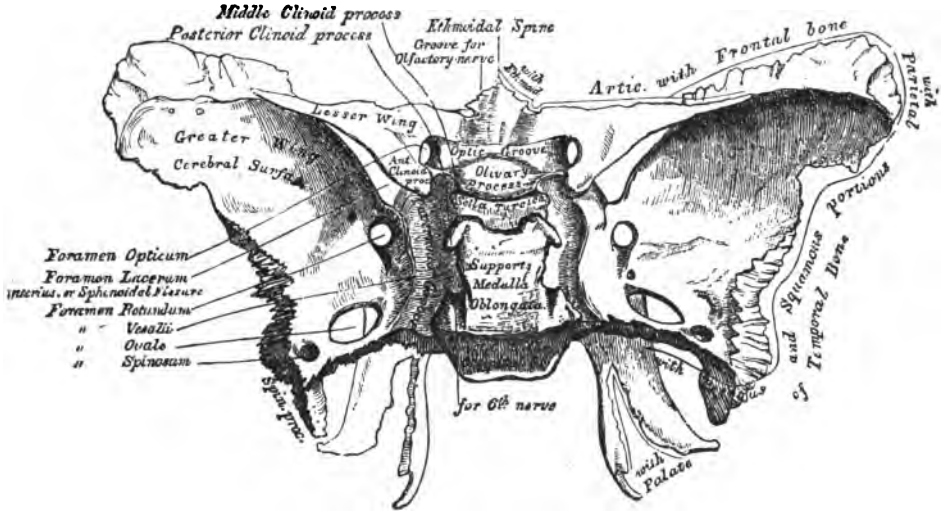


FIG. 37.—THE SPHENOID BONE: UPPER SURFACE. (Gray.)

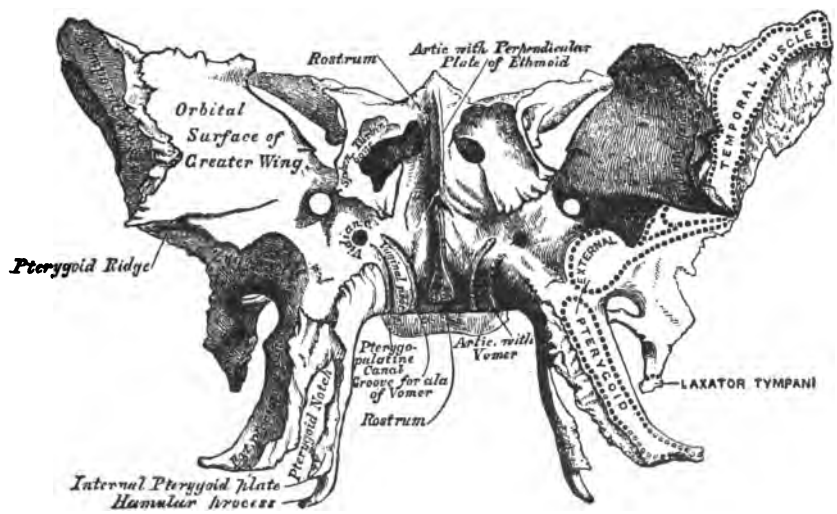


FIG. 38.—THE SPHENOID BONE: ANTERIOR SURFACE. (Gray.)

THE ETHMOID BONE—1st Tablet.

Light, spongy, cuboid, projects downwards from between orbital plates of frontal, and enters into formation of orbits & nasal fossæ.

Articulates with *frontal, sphenoid & sphenoidal turbinated bones, both nasal, superior maxillary, lachrymal, palate, inferior turbinated & vomer.*

May be divided into three parts :

HORIZONTAL OR CRIBRIFORM PLATE — Received into ethmoidal notch of frontal.

Forms part of roof of nose & of anterior fossa of base of skull, and presents in the median line the

Crista galli, which gives attachment to falx cerebri, and articulates below & in front with frontal bone, completing foramen cæcum; – and on each side

Three rows of foramina for branches of the olfactory nerve, and more anteriorly a

Fissure for nasal branch of ophthalmic nerve.

PERPENDICULAR PLATE — Descends from under surface of former, and assists in forming nasal septum.

Is more or less inclined to one or other side, and presents numerous grooves for branches of olfactory nerve.

Articulates in front with frontal spine and nasal bones, behind with crest of sphenoid & vomer, and joins below with triangular cartilage of nose.

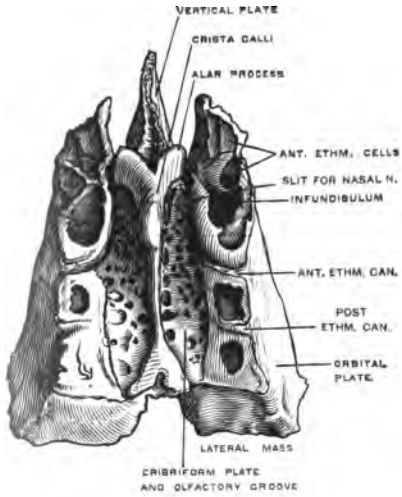


FIG. 39.—THE ETHMOID: UPPER SURFACE. (Quain.)

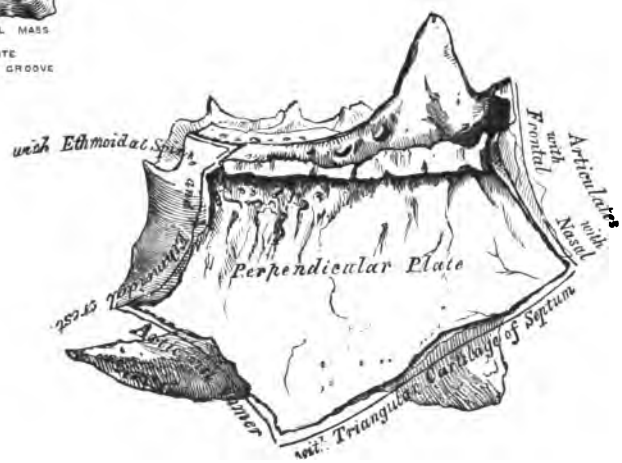


FIG. 40.—THE ETHMOID: OUTER SURFACE OF RIGHT LATERAL MASS (ENLARGED). (Gray.)

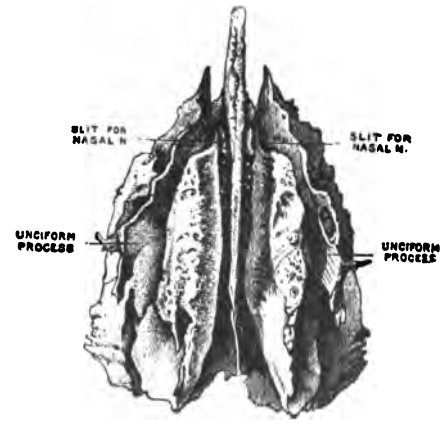


FIG. 41.—THE ETHMOID: UNDER SURFACE. (Sappe

THE ETHMOID BONE—2nd Tablet.

LATERAL MASSES — Cuboid, and enclose a number of irregular cavities, the ethmoid cells, which are divided into an anterior & a posterior set. Their

Anterior, Upper & Posterior Surfaces – Present numerous half-cells, which are completed respectively by articulation with

Lachrymal bones & nasal processes of superior maxilla,
Frontal bone,
Sphenoidal turbinated bones & orbital processes of palate bones. – The upper surface also presents two grooves which assist in forming the anterior & posterior ethmoidal foramina.

Outer Surface – Presents a thin smooth plate of bone the *os planum* which forms inner wall of orbit, and articulates with:

Lachrymal bone, in front;
Orbital plate of frontal, above;
Body of sphenoid, behind;
Superior maxillary & orbital process of palate bone, below.

Under Surface – Presents under surface of middle turbinated process and the projecting *Unciform process,* which articulates with inferior turbinated bone, and assists in forming inner wall of the antrum of Highmore.

Inner Surface – Forms part of outer wall of nasal fossæ, and presents from above downwards the

Superior turbinated process, small and corresponding to post. part of nasal fossæ;
Superior meatus, which communicates with posterior ethmoidal cells;
Middle turbinated process, which extends along whole length of lateral mass;
Middle meatus, which communicates with the anterior ethmoidal cells (and through these with the frontal sinus) by means of a wide funnel-shaped canal, the *Infundibulum.*

FIG. 42.—THE ETHMOID : OUTER SURFACE OF RIGHT LATERAL MASS (ENLARGED). (Gray.)

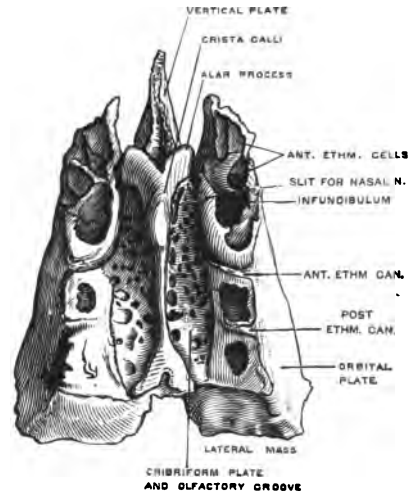


FIG. 43.—THE ETHMOID : UPPER SURFACE. (Quain.)

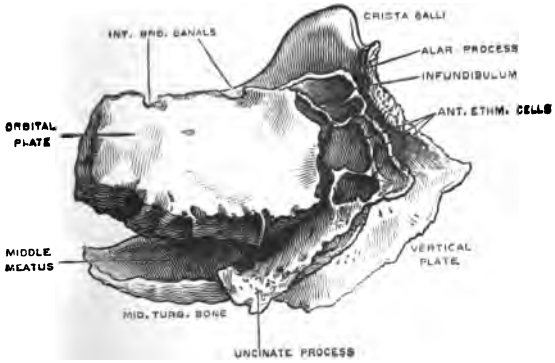


FIG. 44. —THE ETHMOID : OUTER SURFACE OF RIGHT LATERAL MASS. (Quain.)

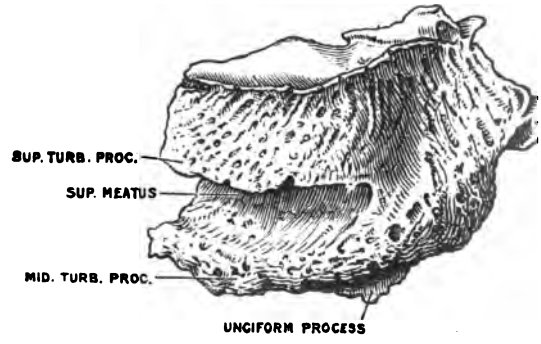


FIG. 45. — THE ETHMOID : INNER SURFACE OF LEFT LATERAL MASS (ENLARGED). (Quain.)

THE PARIETAL BONE.

Articulates with [illegible] frontal. – Presents:

OUTER SURFACE — Convex, and presents:

[illegible] temporal ridge at upper & back part.

[illegible] tubercle

[illegible] ridge which with [illegible] forms part of temporal line.

INNER SURFACE — Concave, and presents:

[illegible] vessels & lacunae

[illegible] for ramifications of middle meningeal artery.

[illegible] for superior longitudinal sinus & Pacchionian bodies.

[illegible] for Pacchionian bodies.

BORDERS — Four:

Superior – Form sagittal suture by articulating with each other;

Inferior – Are

In front – Bevelled externally & overlapped by great wing of sphenoid & squamous portion of temporal;

[illegible] – Serrated for articulation with mastoid portion of temporal.

Anterior – Serrated, and form coronal suture by articulating with frontal.

Posterior – Serrated, and form lambdoid suture by articulating with occipital.

ANGLES — Four

Anterior Superior & Posterior Superior – Correspond to anterior & posterior fontanelles, and form part of foregoing sutures.

Anterior Inferior – Received between frontal & great wing of sphenoid, an inch above and behind superior external angle of orbit. – Is grooved internally and sometimes channelled for anterior branch of middle meningeal artery.

Posterior Inferior – Articulates with mastoid portion of temporal, and presents part of groove for lateral sinus.

[illegible]

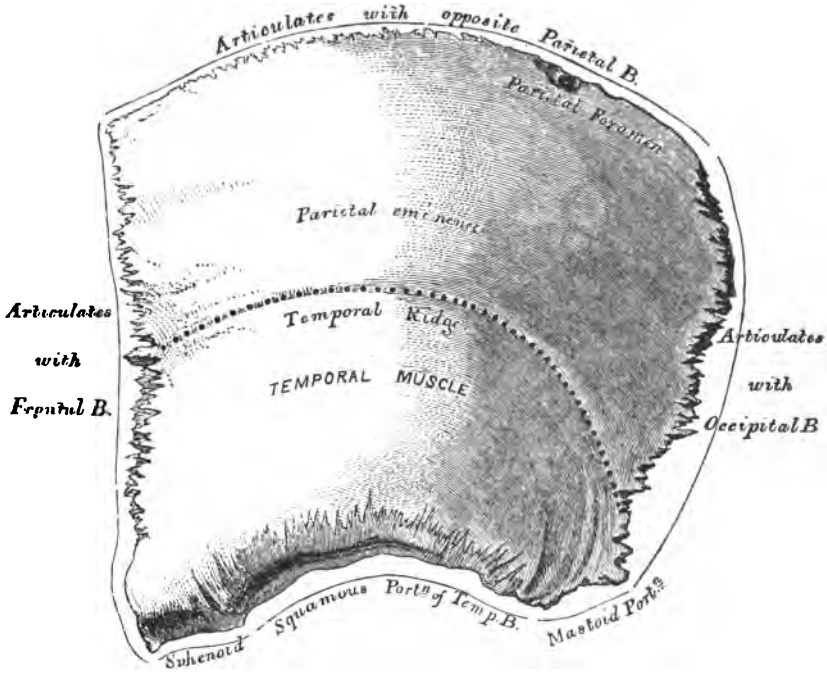


FIG. 46.—THE LEFT PARIETAL BONE: OUTER SURFACE. (Gray.)

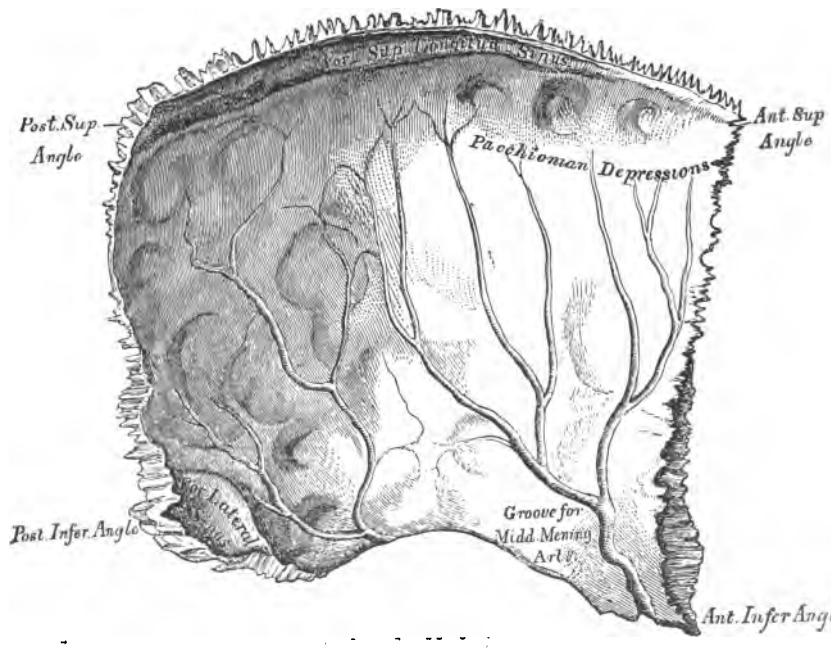


FIG. 47.—THE LEFT PARIETAL BONE: INNER SURFACE. (Gray.)

THE

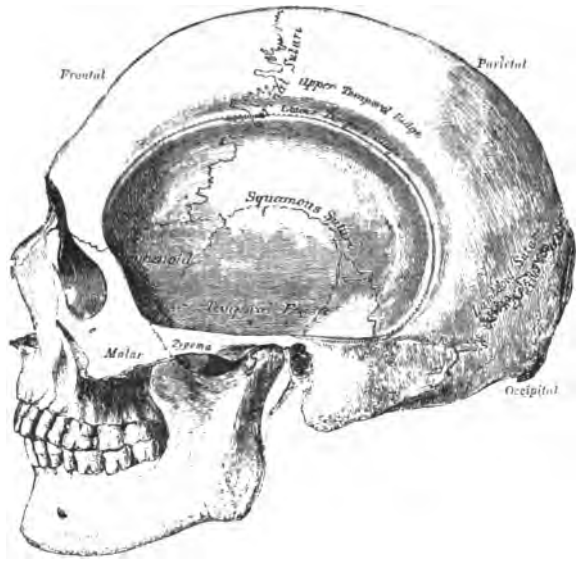


FIG. 52. (Gray, later Eds.)

ments, – epicranial aponeurosis in the one case, temporal fascia at its continuance with the pericranium in the other), – and a *lower one*, superior curved line proper, inferior temporal ridge (for the muscular attachments given in the Tablets). It is admittedly undesirable to present any but well-accepted views in a book for beginners. But so much has been made, in this connection, of the tendencies of the day, – "the search after the infinitely little" (Sir Dyce Duckworth), – that it may be well to put the student on his guard, even at the earliest stage of his studies, against accepting without verification much of the newer matter now found in text-books. Figures 31, 46, and 81, or their equivalents, have been before anatomists of every country, and of every age since drawing was called in to aid anatomical work, and they have never been objected to until lately as being in any way incorrect. Comes, however, a theory giving prominence to fasciæ generally (a point dealt with in some detail in Part II., page 108a), and, with this theory, new ligaments, and new markings (or supposed markings) on the bones themselves; and new figures showing these come to displace the older ones. *Will the reader take the trouble to verify on the bones he is studying, which set of figures appear to him nearest to truth?* It is significant that at least two leading authorities, Quain and the editors of "Morris's Anatomy," have retained the *old* figure of the side view of the skull.* It is remarkable how, now-a-days, some people seem to adopt everything that is new without asking a question. *In matters of common observation*, newness of statement should, to the Author's mind, rather create the impression that the view is merely the expression of a theory: the scientist has usually seen, and pictured, what he wanted to see. The evil is closely connected with present methods of teaching.

On the outer and front part of the body of the sphenoid, just externally to the olivary process, and internally to the front part of the cavernous groove, there is often found a small *middle clinoid process*, which is not unfrequently connected to the anterior clinoid process by a small spicula of bone. This spicula seems to result from the ossifica-

* In regard to the frequency of occurrence of the lines referred to, the Author has kindly been permitted to go through the collection of skulls in the museum of the Royal College of Surgeons. He finds that the newly described lines are present in about one skull in five or six.

tion of a small fibrous band or ligament normally present, which, when ossified, bounds what is called the *carotico-clinoid foramen.**

On the outer and back part of the body of the sphenoid, between it and the greater wing, and forming the outer boundary of the cavernous groove, is a small process or tongue of bone recently termed the lingula (*lingula*, diminutive of *lingua*, tongue), which is interesting through its being developed from a small special centre recently discovered.

The *dorsum sellæ*, or back of the saddle (*sella, sellæ*, saddle), is sometimes called the dorsum-*ephippii*, which means practically the same thing (*ephippium, ephippii*, covering of a horse, saddle). The posterior aspect of the dorsum sellæ, which supports the pons, is sometimes called the clivus (*clivus, clivi*, an incline).

Each side of the dorsum sellæ presents at its lower part a small *petrosal process*, which articulates with the apex of the petrous portion of the temporal bone.

The crista galli of the ethmoid presents two very similar *alar processes* (not so large as represented in Figs. 37 & 41) which embrace the foramen cœcum, and articulate with the frontal bone.

The old reference to the laxator tympani muscle as traversing the Glasserian fissure has *not* been removed from the Tablets. There the structure is; with a little care anybody can see it. The question whether it is a muscle or not, has nothing to do, to the Author's mind, with the reference or no reference to it in connection with the description of the temporal bone. Notwithstanding modern views, the Author believes that it is a muscle, or was a muscle, or is sometimes a muscle, – whichever may be the best way of putting it. What is muscle but a higher and revertible condition of tendon? (See Sutton's exposition of this point, Part II., p. 168a.)

Some interest attaches to the midde root of the zygoma. It is now often described as the *post-glenoid* tubercle, and is the supposed representative of an elongated piece of bone which, in some mammalia, descends behind the condyle of the lower jaw, and prevents its being dislocated backwards during mastication. Sometimes it is not counted as one of the roots of the zygoma, which are then said to be two in number only, instead of three (Quain). At the outer extremity of the anterior root of the zygoma is the tubercle for the external lateral ligament of the temporo-maxillary articulation.

Interest attaches to the diminutive *mastoid foramen*, the remnant of an important opening in the fœtal skull, through which passed out, at a time when there was no internal jugular vein, the then main vein carrying the blood from the cerebral vesicles, the *external jugular*. As the internal jugular vein developed, the mastoid foramen and the external jugular vein contracted, the vein becoming, in its upper part, the small posterior auricular vein of the adult. (See Part III., page 284f.) The internal opening of the mastoid foramen may be seen (if not closed) in the fossa sigmoidea, or descending portion of the groove for the lateral sinus. Usually it is the *right* lateral sinus that is most directly continuous with the superior longitudinal sinus; and so it is with the respective grooves on the anterior or concave surface of the temporal bone.

The description of the under surface of the base of the skull given on pp. 70 & 73 is largely due to J. A. Fort, a private teacher of anatomy in Paris in the Author's younger days. It is believed to be the description giving the *best groupment* of the "trous, dépressions, crêtes, et surfaces" of this important and interesting part.

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* A similar tendency to ossification is often visible elsewhere, *e.g.*, converting into a bony canal the groove for the posterior palatine artery on the roof of the mouth. All three clinoid processes are sometimes united by bone.

BONES OF THE FACE.

SUPERIOR MAXILLARY BONE—1st Tablet.

Forms the whole of upper jaw by its union with its fellow.
Assists in forming:
Roof of mouth, floor & outer wall of nose, floor of orbit ;
Zygomatic & spheno-maxillary fossæ ;
Spheno-maxillary & pterygo-maxillary fissures.
May be described as presenting a body and four processes, malar, nasal, alveolar & palate.

BODY — Hollowed out to form Antrum of Highmore. – Presents:

OUTER SURFACE — Convex. Presents from within outwards & backwards:
Incisive or myrtiform fossa for depressor alæ nasi,
Canine fossa, large & deep for origin of levator anguli oris & compressor nasi; at upper part of which fossa is the
Infra-orbital foramen for infra-orbital vessels & nerve;
Vertical ridge, which descends from malar process, and behind which is the
Maxillary tuberosity, which is rough along its posterior border for articulation with the palate bone & sometimes with pterygoid process of sphenoid.

INNER SURFACE — Divided into two unequal parts by palate process.
PART ABOVE PALATE PROCESS – Presents from before backwards the
Inferior turbinated crest, above and below which are
Two wide antero-posterior grooves, which form part of middle & inferior meatuses, and the former of which is surmounted by the
Superior turbinated crest, which lies on inner surface of nasal process;
A deep groove which is converted into nasal duct by articulation with lachrymal & inferior turbinated bones;
Aperture of Antrum of Highmore very large in disarticulated bone but diminished in articulated skull by ethmoid, lachrymal, inferior turbinated & palate bones, and presenting inferiorly a fissure into which is received the maxillary process of the palate bone.
A rough surface which articulates with palate bone and is divided into an anterior & a posterior portion by a
Vertical groove, which forms part of posterior palatine canal.
PART BELOW PALATE PROCESS – Forms anterior part of roof of mouth.

UPPER SURFACE — Forms greater part of floor of orbit, and is bounded:
On Inner Side – By a thin edge which articulates from before backwards with lachrymal bone, os planum & orbital process of palate bone.
On Outer Side – By a rounded margin which forms part of spheno-maxillary fissure.
in Front – By lower part of circumference of orbit. – It presents behind
Infra-orbital groove for infra-orbital vessels & nerve, which groove becomes converted in front into
Infra-orbital canal ; – and at its anterior & inner part a
Depression for inferior oblique muscle.

Antrum of Highmore or Maxillary Sinus – Is a large cavity hollowed out of body of the superior maxillary bone
Its walls correspond to the three surfaces of the body of the bone; they are very thin, and contain the infra-orbital & ant .& post. dental canals.
Its aperture communicates with the middle meatus of the nasal fossæ, and is much diminished in size, and generally divided into two by articulation with ethmoid, lachrymal, inferior turbinated & palate bones.
Several laminæ of bone project into its cavity, as do also the roots of the 1st & 2nd molar teeth, which sometimes perforate its floor.

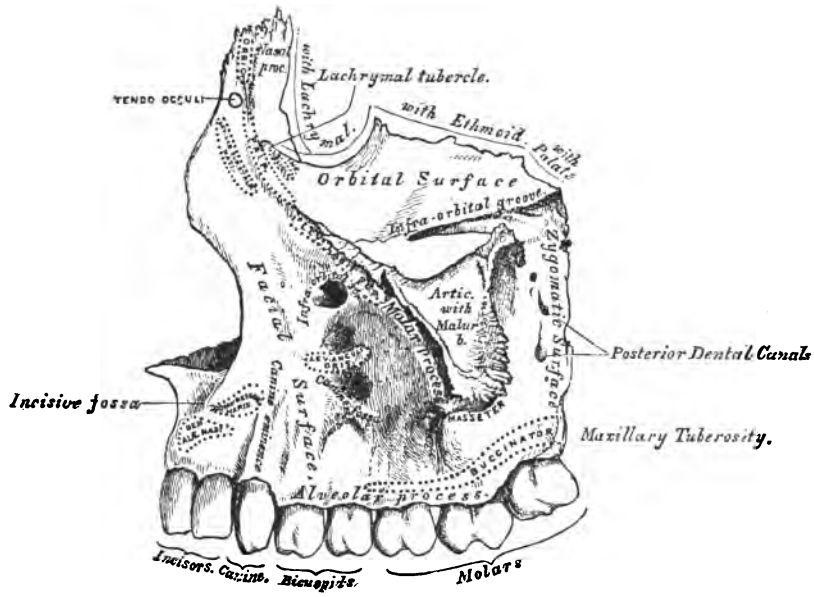


FIG. 53.—THE SUPERIOR MAXILLARY BONE: OUTER SURFACE. (Gray.)

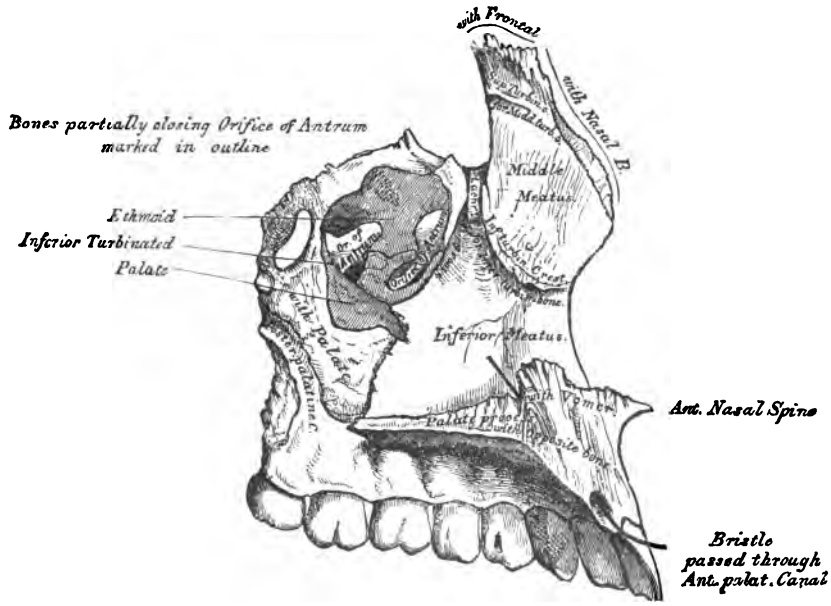
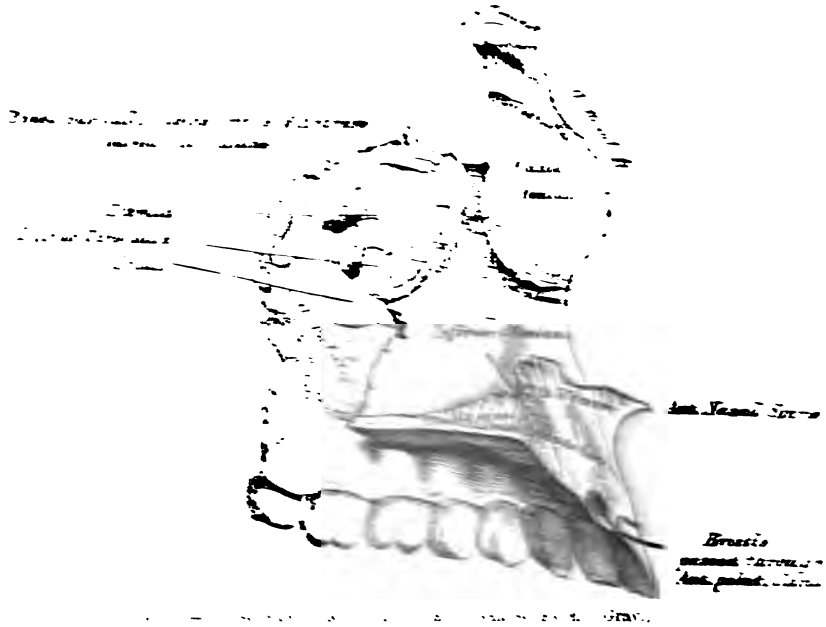


FIG 54.—THE SUPERIOR MAXILLARY BONE: INNER SURFACE. (Gray.)



SUPERIOR MAXILLARY BONE—2nd Tablet.

MALAR PROCESS — Triangular, and presents:

Ant. Surface – Concave, forms part of canine fossa;

Post. Surface – Concave, forms part of zygomatic fossa;

Sup. Surface – Rough for articulation with malar bone.

NASAL PROCESS — Triangular, and presents:

Outer Surface – Concave, gives attachment to orbicularis palpebrarum, tendo oculi levator labii superioris alæque nasi

Inner Surface – Presents from above downwards:
Rough surface, which articulates with ethmoid bone;
Superior turbinated crest which articulates with middle turbinated bone;
Inferior turbinated crest with the two grooves already described.

Ant. Border – Thin, serrated above for articulation with nasal bone, and continuous below with margin of the deep notch, which bounds laterally the anterior aperture of the nasal fossæ

Post. Border – Presents a groove which forms part of nasal duct, of which groove the
Inner margin articulates with lachrymal bone, while the
Outer margin forms part of circumference of orbit, and presents the
Lachrymal tubercle at its junction with orbital surface.

ALVEOLAR PROCESS — Forms a curve of a semi-horse-shoe shape. Is thicker behind than in front, and presents eight alveoli in adults, five in children

PALATE PROCESS — Presents:

Upper Surface – Concave from side to side. Forms part of floor of nasal fossa, and presents in front the
Incisor foramen or *foramen of Stenson*, which is completed on its inner side by a thin lamina of bone directed backwards from its anterior to its posterior border (from the latter of which this lamina remains disconnected in youth). This foramen leads below into the
Anterior palatine canal formed by the junction of the two bones, into which canal when it is viewed from below, are also seen to open two other small foramina, the
Foramina of Scarpa situated in the suture between the two laminæ. The foramina of Stenson transmit the anterior palatine vessels while the foramina of Scarpa transmit the naso-palatine nerves of which the right one is said to be posterior to the left.

Under Surface – Concave, rough, forms part of roof of mouth. – Is channelled by
Groove (sometimes by a canal) for the posterior palatine vessels & anterior or great palatine nerve, and presents behind anterior part of lower orifice of
Posterior palatine canal. †

Inner Border – Raised into a ridge which forms with its fellow a groove for vomer and presents in front the
Anterior nasal spine.

Ant. Border – Forms lower part of anterior aperture of nasal fossæ.

Post. Border – Articulates with horizontal plate of palate bone.

† For foramina of Stenson & Scarpa, see Roof of Mouth, p. 70.

THE PALATE BONE—1st Tablet.

Presents *horizontal* and *vertical plates*, –from the point of junction of which two plates the *pterygoid process* projects backwards & outwards, –while from the upper border of the vertical plate project upwards, the *orbital process* in front, and the *sphenoidal process* behind.
It articulates with *its fellow, the superior maxilla, sphenoid, ethmoid, inferior turbinated & vomer.*
It assists in forming –principally, the *floor & outer wall of the nasal fossa and the roof of the mouth,* and –secondarily, the *floor of the orbit, the pterygoid & spheno-maxillary fossæ, and the inner wall of the Antrum of Highmore.*

HORIZONTAL PLATE — Presents:

SUP. OR NASAL SURFACE – Smooth and concave from side to side, forms posterior part of floor of nasal fossa.

INF. OR BUCCAL SURFACE – Rough, marked posteriorly by a
Transverse ridge for attachment of aponeurosis of tensor palati, and more externally by a
Deep notch, which assists in forming the posterior palatine foramen. A little further back, on the under surface of the pterygoid process, are the
External & posterior small palatine foramina for external and posterior palatine nerves.

ANTERIOR BORDER – Serrated for articulation with palate process of superior maxilla.

POSTERIOR BORDER – Free for attachment of soft palate.

INNER BORDER – Thick, surmounted by a ridge, which forms with its fellow a groove for vomer; presents posteriorly the
Posterior nasal spine for azygos uvulæ.

VERTICAL PLATE — Presents:

INNER SURFACE – Presents the
Superior & ~~middle~~ turbinated crests, above, between & below which are seen
A narrow & two wider horizontal grooves, which form part respectively of the superior, middle & inferior meatuses.

OUTER SURFACE – Presents towards its middle a
Smooth surface, which forms the inner wall of the spheno-maxillary fossa, and is prolonged inferiorly into a
Vertical groove, which assists in forming the posterior palatine canal. In front of these is a
Rough surface, which articulates with the superior maxilla; and further forwards still a
Narrow smooth surface, which forms part of inner wall of antrum. Behind is a
Rough surface, which articulates above with the pterygoid process of the sphenoid, below with the superior maxilla.

ANTERIOR BORDER – Thin, irregular, presents a projecting lamina, the
Maxillary process, which assists in closing the lower part of the orifice of the antrum, and, forming a schindylesis, penetrates into a fissure of the superior maxilla at the lower part of that orifice.

POSTERIOR BORDER – Articulates with the inner plate of the pterygoid process.

UPPER BORDER – Presents the
Orbital process in front, the *Sphenoidal process* behind, which processes are separated by a deep
Notch forming the greater part of the spheno-palatine foramen (which foramen is completed above by the sphenoidal turbinated bone).

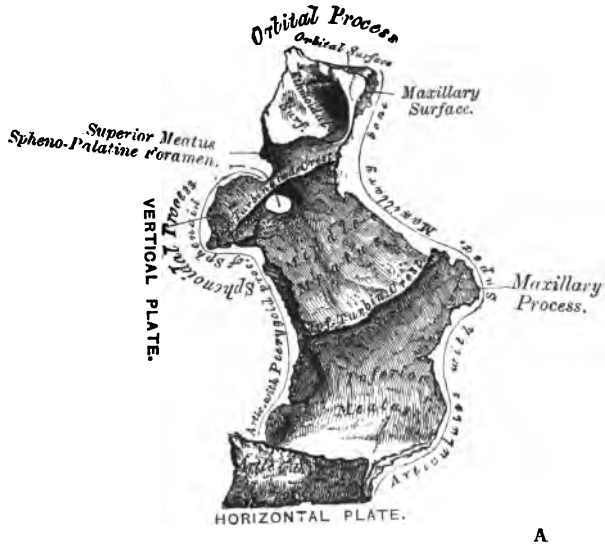


FIG. 57.—THE LEFT PALATE BONE : INTERNAL VIEW (ENLARGED). (Gray.)

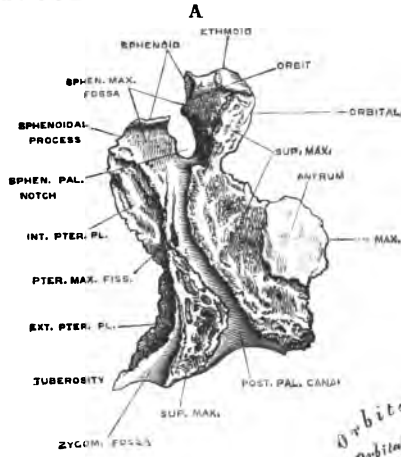


FIG. 58.—THE RIGHT PALATE BONE : EXTERNAL VIEW. (Quain.)

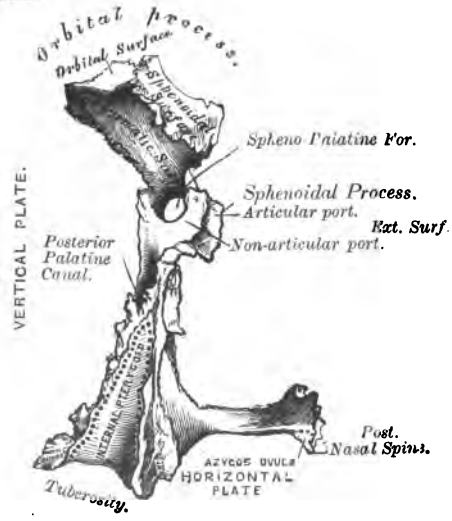


FIG. 59.—THE LEFT PALATE BONE : POSTERIOR VIEW (ENLARGED). (Gray.)

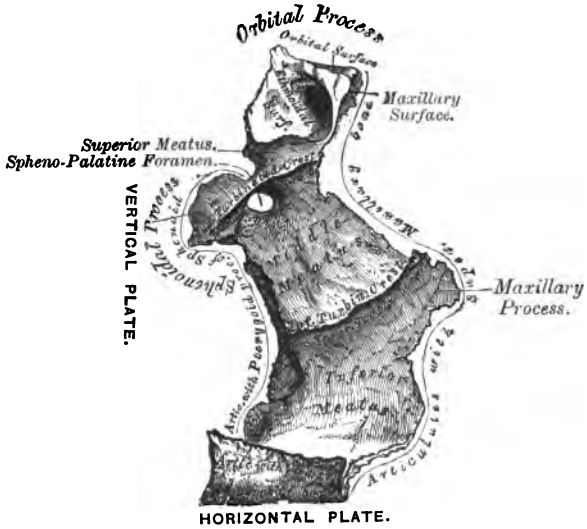


FIG. 60.—THE LEFT PALATE BONE: INTERNAL VIEW ENLARGED). (Gray.)

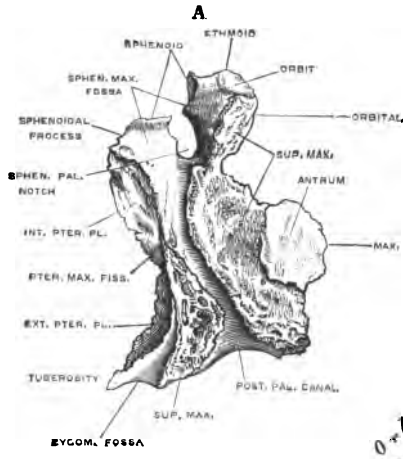


FIG. 61.—THE RIGHT PALATE BONE: EXTERNAL VIEW. (Quain.)

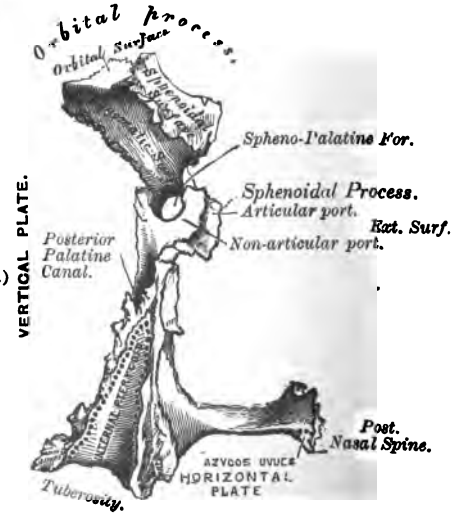


FIG. 62.—THE LEFT PALATE BONE: POSTERIOR VIEW (ENLARGED). (Gray.)

THE PALATE BONE—2nd Tablet.

PTERYGOID PROCESS — Fits into the notch between the two plates of the pterygoid pro
of the sphenoid bone, and prese

Fig 62 POSTERIOR SURFACE – Triangular, concave, forms part of pterygoid fossa.

" 62 TWO LATERAL SURFACES – Rough, articulate with the two plates of the pterygoid process & v
the superior max

UNDER SURFACE – Forms part of the roof of the mouth, and presents the
External & posterior small palatine foramina for external & posterior palatine nerves.

ORBITAL PROCESS — Projects upwards & outwards from the anterior part of the upper bo
of the vertical plate, and prese

THREE ARTICULAR SURFACES – *Anterior, posterior & internal,* – which join respectively with the *supe*
maxillary bone, the sphenoidal turbinated bone & the lateral mass of the ethn

TWO NON-ARTICULAR SURFACES :–

Fig 60 *Superior or Orbital* – Forms posterior part of floor of orbit;

External or Spheno-maxillary – Forms part of inner wall of spheno-maxillary fossa, an
Fig 61 separated from the foregoing b

Rounded border, which forms part of spheno-maxillary fissure.

SPHENOIDAL PROCESS — Curves upwards, backwards & inwards, and presents:

Fig 62 UPPER SURFACE – Articulates with sphenoid & sphenoidal turbinated bones, and assists in
ming pterygo-palatine ca

Fig 62 OUTER SURFACE – Articulates behind with pterygoid process, and forms in front that small
of inner wall of spheno-maxillary fossa, which lies behind spheno-palat. foran

Fig 63 INNER SURFACE – Concave, forms part of outer wall of nasal fossa.

THE SMALL BONES of the FACE.

NASAL BONES — Form bridge of nose. – Narrow & thick above, wide and thin below. Present:

Fig 63 **Outer Surface** – Convex from side to side, concave from above downwards at upper part. Presents several arterial grooves and a foramen for a small vein.

" 64 **Inner Surface** – Inversely curved; presents a groove for external branch of nasal nerve.

Borders:

SUPERIOR – Narrow, thick, articulates with frontal;
INFERIOR – Broad, thin, joined to lateral cartilage of nose; has a notch for nasal nerve;
EXTERNAL – Articulates with nasal process of superior maxillary bone;
INTERNAL – Thick, articulates with its fellow; is prolonged backwards into a crest which articulates with nasal spine of frontal & perpendicular plate of ethmoid.

LACHRYMAL BONES — Form front part of inner wall of orbit. Present

Outer Surface – Presents from before backwards:
Groove, which forms part of nasal duct;
Ridge, which gives attachment to tensor tarsi muscle;
Smooth surface, which forms part of inner wall of orbit.

Inner Surface – Presents a furrow corresponding to foregoing ridge; forms part in front of middle meatus, and articulates behind with ethmoid bone.

Borders:

ANTERIOR, SUPERIOR, POSTERIOR – Articulate respectively with nasal & internal angular processes of superior maxillary & frontal bones, and with os planum of ethmoid.
INFERIOR – Articulates behind with orbital plate of superior maxillary, and, in front, is prolonged downwards into a pointed process, *the hamulus lachrymalis*, which articulates with lachrymal process of inferior turbinated bone.

MALAR BONES* — Articulate with temporal, frontal, sphenoid & superior maxillary bones, and form part of outer wall & floor of orbit, and of temporal & zygomatic fossæ. Present:

Outer Surface – Convex; presents a small malar foramen for malar branch of temporo-malar nerve, and gives attachment to the zygomatic muscles.

Inner Surface – Articulates internally with superior maxillary bone by a rough triangular surface, and is concave externally, where forms part of temporal & zygomatic fossæ and presents a foramen for temporal branch of temporo-malar nerve.

Orbital Process – Projects backwards forming part of outer wall & floor of orbit & of temporal fossa; articulates from above downwards with frontal, sphenoid & superior maxillary bones, and bounds spheno-maxillary fissure anteriorly. – On its inner surface it presents one or two temporo-malar foramina.

Frontal Process – Thick, vertical, articulates with external angular process of frontal.

Zygomatic Process – Long, horizontal, articulates with zygomatic process of temporal.

Borders:

ANTERO-SUPERIOR – Forms lower & outer part of circumference of orbit.
ANTERO-INFERIOR – Articulates with superior maxillary bone.
POSTERO-SUPERIOR & POSTERO-INFERIOR – Are continuous with superior and inferior margins of zygomatic process.

INFERIOR TURBINATED BONES — Thin, and extend along whole length of outer wall of nasal fossa. Present:

Outer concave & **Inner** convex **Surfaces**, marked by vascular grooves and canals, and the latter of which looks upwards & inwards.

Upper Border – Which, from before backwards:
Articulates with inferior turbinated crest of superior maxillary;
Forms *lachrymal process*, which articulates with lachrymal & superior maxillary bones and completes nasal duct;
Presents *maxillary process*, which curves downwards and outwards over lower edge of orifice of antrum of Highmore.
Presents *ethmoidal process*, which ascends to join uncifrom process of ethmoid.

Lower Border – Is free and slightly thickened.

VOMER — Forms posterior part of nasal septum, and is frequently bent to one or other side. Presents:

Lateral Surfaces – Present vascular & nervous furrows, and naso-palatine groove for naso-palatine nerve.

Superior Border – Presents a deep groove bounded by two projecting *alæ*, between which the rostrum of the sphenoid is received, and which are overlapped inferiorly by the vaginal processes of the same bone.

Inferior Border – Articulates with ridge formed by palate plates of superior maxillary & palate bones.

Anterior Border – Is grooved above for articulation with perpendicular plate of ethmoid and joined below to cartilage of the septum.

Posterior Border – Free, thicker above than below; separates posterior apertures of the nares

* See Figs. 73 and 74, p. 68.

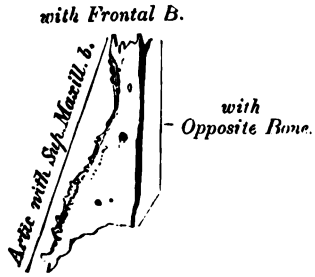


FIG. 63.— THE RIGHT NASAL BONE. (Gray.)

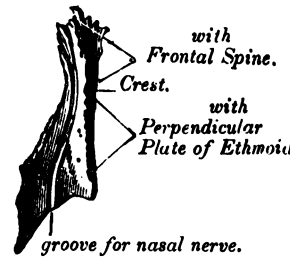


FIG. 64.— THE LEFT NASAL BONE. (Gray.)

FIG. 65. —RIGHT INFERIOR TURBINATED BONE : OUTER SURFACE. (Gray.)

FIG. 66.—RIGHT INFERIOR TURBINATED BONE : INTERNAL SURFACE. (Gray.)

FIG 67.—THE LEFT LACHRYMAL BONE : EXTERNAL SURFACE (SLIGHTLY ENLARGED). (Gray.)

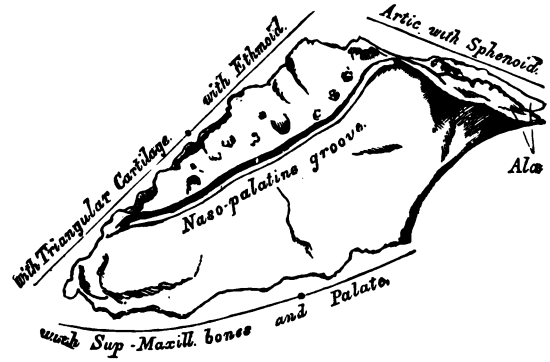


FIG. 68.—THE VOMER. (Gray.)

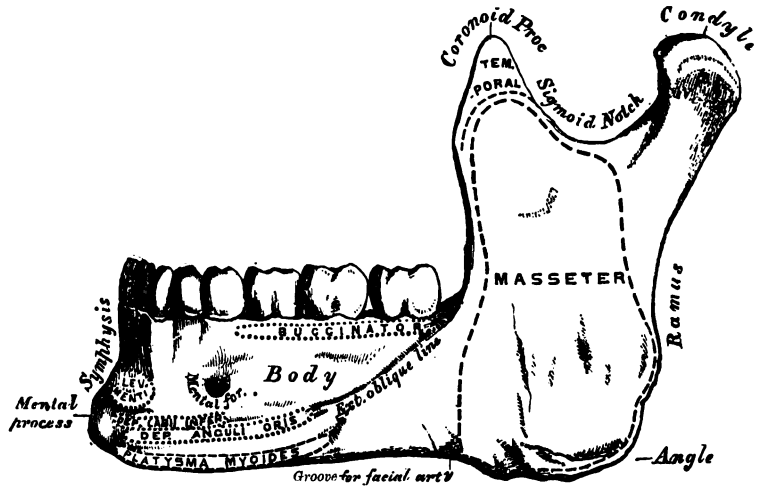


FIG. 69.—THE INFERIOR MAXILLARY BONE: OUTER SURFACE. (Gray.)

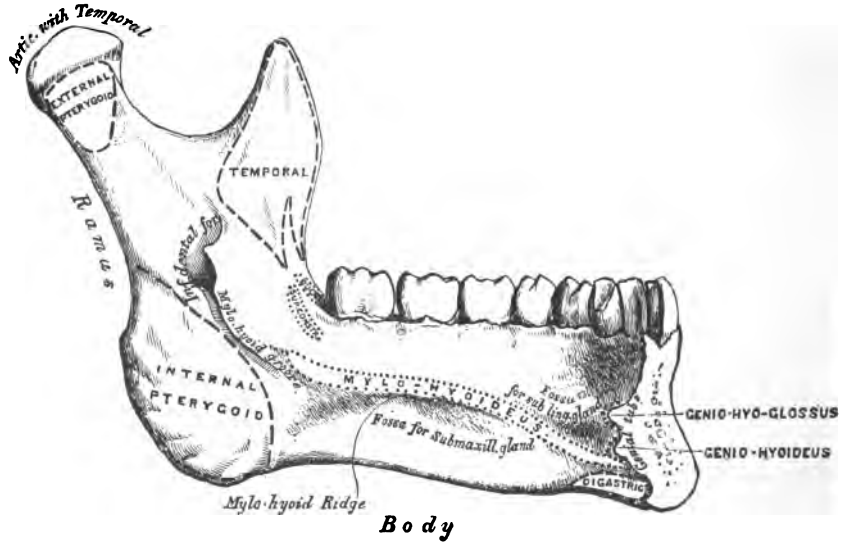


FIG. 70.—THE INFERIOR MAXILLARY BONE: INNER SURFACE. (Gray.)

INFERIOR MAXILLARY BONE.

is curved upon itself, and consists of a middle horizontal portion, the body, and of two latera vertical portions, the rami

BODY — Presents:

EXT. SURFACE — Convex from side to side and concave from above downwards. Presents in median line the

Symphysis, a vertical ridge, at the lower part of which is the

Mental process, from which the

External oblique line passes backwards, first horizontally, giving attachment to depressores labii inferioris & anguli oris, and then obliquely & becoming continuous with anterior border of ramus. – Laterally above the oblique line is the

Incisive fossa for levator menti; and more externally the

Mental foramen for mental vessels & nerve.

The Buccinator is attached above oblique line behind, and the platysma, below it, in front

INT. SURFACE — Concave from side to side and convex from above downwards. Presents the

Symphysis forming a linear depression, close to which near its middle are the superior & inferior pairs of

Genial tubercles giving attachment respectively to the genio-hyo-glossi & genio-hyoidei. Below these tubercles begins the

Internal oblique line or *mylo-hyoid ridge* for mylo-hyoid muscle, faintly marked at first, but becoming more distinct as it passes upwards & backwards. – Above & below this line are seen near the sym. physis the

Sublingual fossa for sublingual gland;

Rough depression for anterior belly of digastric; and more externally

Submaxillary fossa for submaxillary gland.

Above posterior extremity of mylo-hyoid ridge is attached the superior constrictor of the pharynx

SUP. BORDER — Thickest behind, where it is dejected inwards; presents sixteen alveolæ in the adult, ten in the child

INF. BORDER — Thickest and slightly everted anteriorly.

RAMI — Are quadrilateral, and present:

EXT. SURFACE — Marked by oblique ridges for masseter.

INT. SURFACE — Presents near middle

Aperture of inferior dental canal, of which the anterior margin forms a prominent

Spine for internal lateral ligament of lower jaw; – and from which passes downwards & forwards the

Mylo-hyoid groove for mylo-hyoid vessels & nerve, behind which groove is s

Rough surface for internal pterygoid muscle.

UPPER BORDER — Presents the coronoid & condyloid processes separated by sigmoid notch

Coronoid process – Triangular, gives attachment by its surfaces & borders to temporal muscle, and presents at its lower & front part a groove which is continued downwards upon the alveolar process, and which gives attachment inferiorly to the buccinator muscle.

Condyloid process – Consists of

Condyle – Oblong, convex from side to side and from before backwards & nearly transverse, its long axis when prolonged, meeting that o its fellow near anterior margin of foramen magnum

Neck – Flattened from before backwards, convex behind, excavated in front for external pterygoid muscle, presenting externally a tubercle for external lateral ligament of jaw

ANTERIOR BORDER — Continuous with external oblique line; thin above thicker below where grooved for buccinator

LOWER & POSTERIOR BORDERS — Thick and form inferiorly the

Angle of the jaw, which gives attachment to masseter & internal pterygoic muscles and to stylo-maxillary ligament

HYOID BONE.

Horse-shoe shaped, and suspended by stylo-hyoid ligaments from tips of styloid processes of temporal bones. Consists in youth of five parts, the body and the greater & lesser cornua, which parts are joined together by four arthrodiæ; the cornua usually join with the body, the greater ones towards the middle period of life, the lesser ones in advanced age.

BODY — Quadrilateral. Presents:

Anterior Surface - Convex, looks upwards & forwards, and is marked by a crucial ridge. The part above the ridge gives attachment to the hyo-glossus, genio-hyo-glossus & genio-hyoid; the part below the ridge gives attachment to the mylo-hyoid, the stylo-hyoid & the aponeurosis of the digastric.

Posterior Surface - Smooth, concave; looks backwards & downwards, and is separated from the epiglottis & the thyro-hyoid membrane by a quantity of loose areolar tissue, in which a bursa is usually found.

Upper Border - Thick & rounded; gives attachment to genio-hyo-glossus by its anterior lip, to thyro-hyoid membrane by its posterior lip.

Lower Border - Thinner; gives attachment to sterno-, omo-, & thyro-hyoid.

GREATER CORNU — Projects backwards & slightly upwards, giving attachment superiorly to the hyo-glossus, internally to the middle constrictor of the pharynx, and externally to the thyro-hyoid. It diminishes in size from before backwards, and is flattened from above downwards. Its slightly enlarged extremity gives attachment to the lateral thyro-hyoid ligament.

LESSER CORNU — Small, conical; projects upwards & backwards from point of junction of body & greater cornu, and gives attachment to the stylo-hyoid ligament.

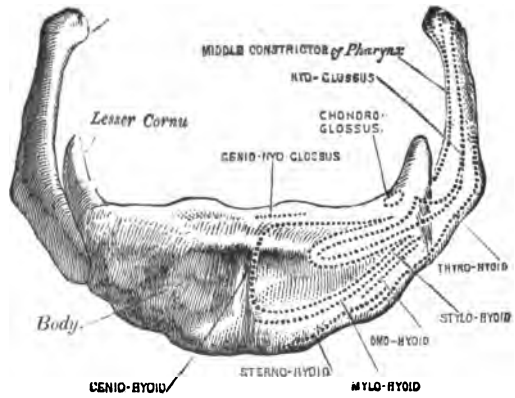


FIG. 71.—THE HYOID BONE, ENLARGED : ANTERIOR VIEW. (Gray.)

FIG. 72.—THE HYOID BONE : A, ANTERIOR VIEW ; B, POSTERIOR VIEW. (Sappey.)

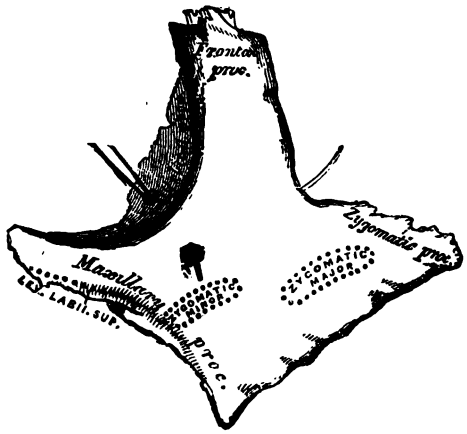


FIG. 73.—LEFT MALAR BONE: OUTER SURFACE. (Gray.)

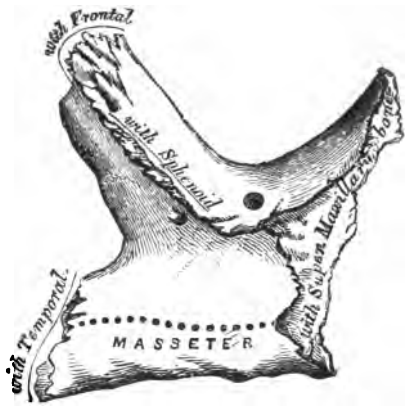


FIG. 74.—LEFT MALAR BONE: INNER SURFACE. (Gray.)

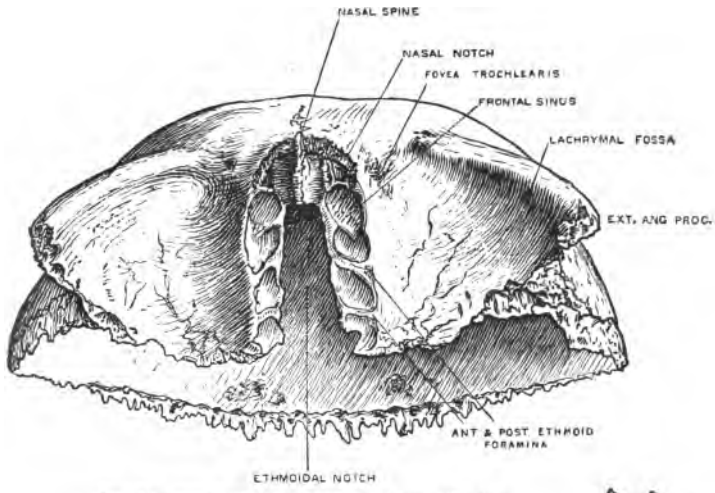


FIG. 75.—THE FRONTAL BONE, FROM BELOW. (Quain.)

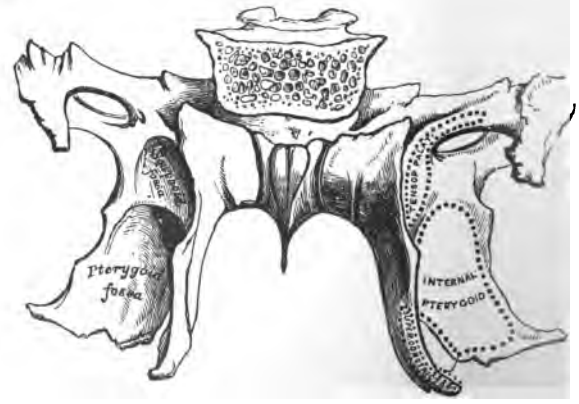


FIG. 76.—THE SPHENOID BONE: POSTERIOR SURFACE. (Gray.)

THE SKULL AND FACE IN GENERAL.

UNDER SURFACE of BASE of SKULL.

Is bounded from before backwards by:
Alveolar arch & teeth of upper jaw;
Lower border of malar bone, zygoma & imaginary line from zygoma to mastoid process;
Superior curved line of occipital bone.

Grouping points of interest on under surface of skull, the latter may be said to present from before backwards:

Roof of Mouth;
Posterior Aperture of Nares:
Under Surface of Basilar Process, on each side of which is a
Quadrilateral Space, the angles of which are formed by the CONDYLE of the occipital bone, and by the PTERYGOID, ZYGOMATIC and MASTOID PROCESSES.
Under Surface of Remaining Part of Occipital Bone.

ROOF OF THE MOUTH

Is formed by palate processes of superior maxillary & horizontal plates of palate bones, and is bounded laterally & in front by alveolar arch.

Is concave, uneven & marked by a crucial suture, and presents from before backwards & outwards:

Lower opening of anterior palatine canal, into which may be seen to open, laterally
Foramina of Stenson for anterior palatine vessels, and in middle line,
Foramina of Scarpa for naso-palatine nerves;
A groove leading to
Posterior palatine foramen for post. palatine vessels & ant. or great palatine n.;
Transverse ridge for attachment of aponeurosis of tensor palati;
Accessory or small palatine foramina, posterior & external, for posterior or small, and the external palatine nerves.

POSTERIOR APERTURE OF THE NARES

Is bounded by body of sphenoid, horizontal plate of palate bone, and inner plates of pterygoid processes, which latter present inferiorly

Hamular process for reflection of tendon of tensor palati, and superiorly,
Scaphoid fossa for origin of that muscle.

Is divided into two by vomer, and presents inferiorly
Posterior nasal spine for origin of azygos uvulæ, and superiorly
Expanded alæ of vomer, which articulate with rostrum & with vaginal processes of sphenoid, and on either side of which are
Pterygo-palatine canals formed in part by sphenoid & in part by palate bones, and giving passage to pterygo-palatine vessels & nerves.

UNDER SURFACE OF THE BASILAR PROCESS

Presents in middle line
Pharyngeal spine for median raphe & superior constrictor of pharynx, and laterally,
Rough depressions for insertion of recti capitis antici major & minor.

QUADRILATERAL SPACE—V. next Tablet.

UNDER SURFACE OF THE OCCIPITAL BONE (REMAINING PART) — Presents:

Foramen magnum for cord & its membranes, vertebral arteries & spinal accessory nerves, on outer side of which foramen are
Condyles of occipital bone having
Jugular process on their outer side,
Anterior condyloid foramen in front,
Posterior condyloid fossa sometimes perforated by the *posterior condyloid foramen* behind.
Ext. Occipital Crest giving off laterally
Superior & Inferior curved lines, and ending posteriorly in
External occipital protuberance,
For parts just mentioned see Occipital Bone.

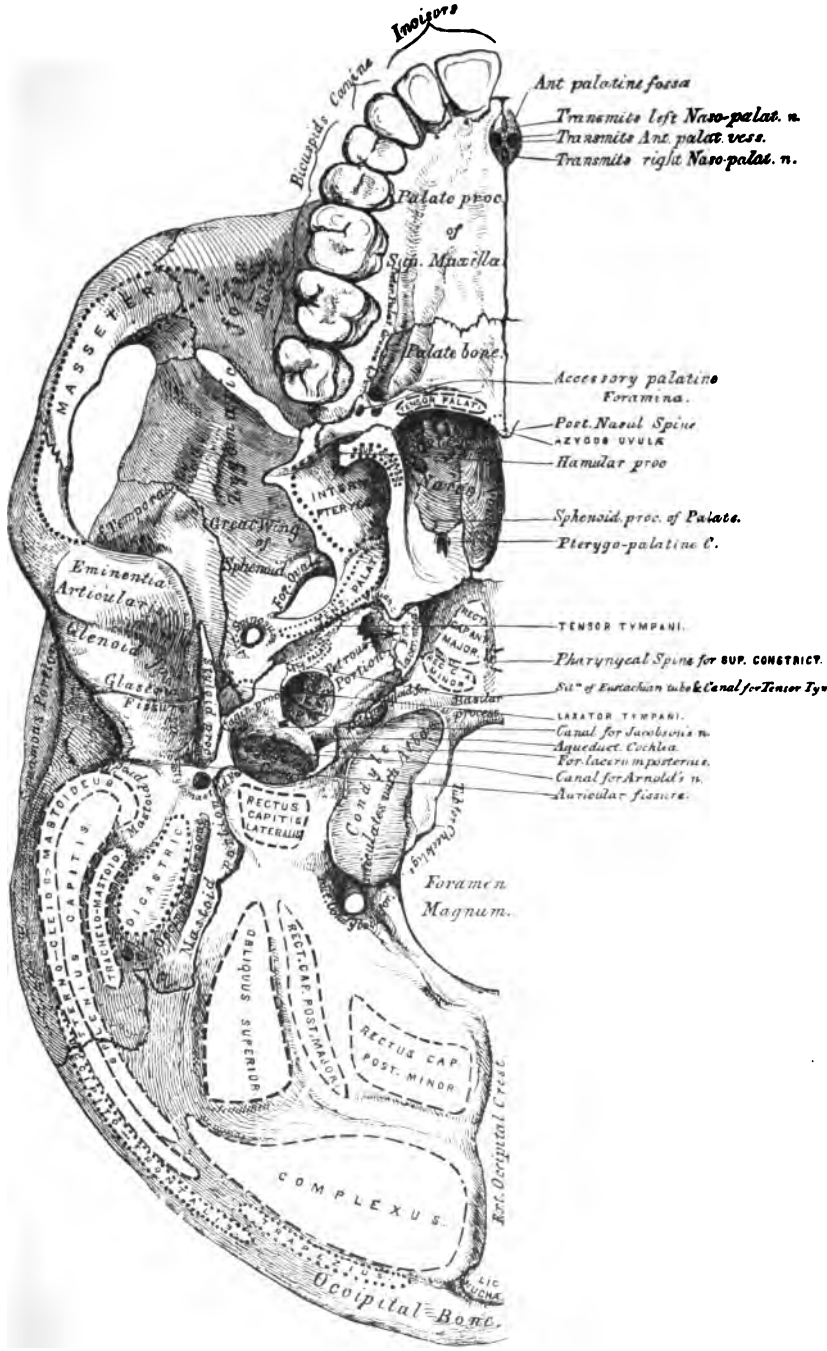


FIG. 77.—BASE OF SKULL. UNDER SURFACE. (Gray.

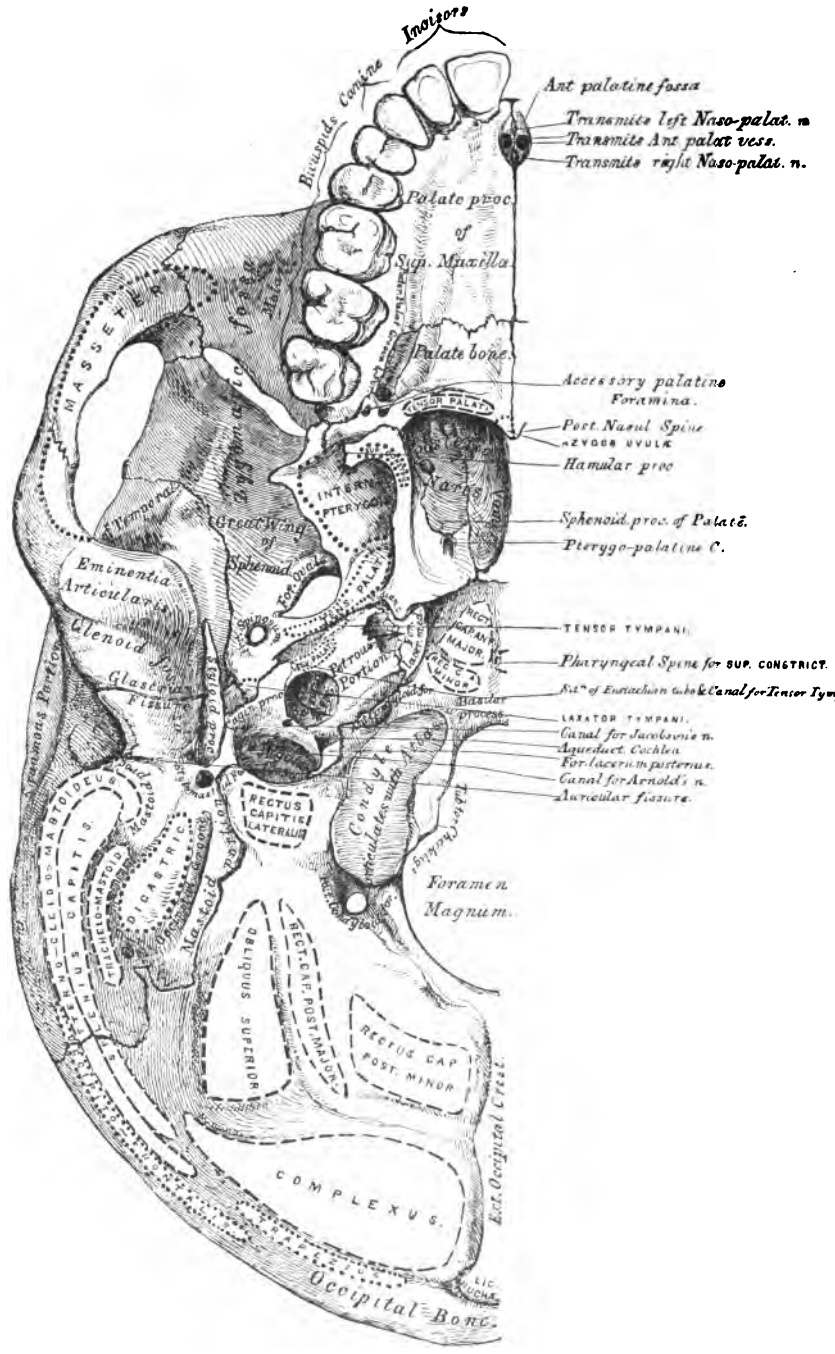


FIG. 78.—BASE OF SKULL. UNDER SURFACE. (Gray.)

QUADRILATERAL SPACE.

Is formed by the under surfaces of the occipital bone and of the squamous & petrous portions of the temporal and of the greater wing of the sphenoid, and is situated on either side of the basilar process.

It is quadrangular.

ITS ANGLES

Are formed by the Condyles of the occipital bone and by the Pterygoid, Zygomatic & Mastoid processes. (Vide these parts in respective Tablets.)

It is divided in two by a well marked diagonal line obliquely directed from before backwards & outwards, and presents points of interest both in front of & behind its diagonal line.

ITS DIAGONAL LINE

Extends from the root of the pterygoid to the mastoid process, and presents from before backwards & outwards the

Foramen lacerum medium closed by cartilage, and crossed superiorly by the internal carotid artery & the Vidian nerve;

Rough surface for origin of levator palati & tensor tympani;
Inf. orifice of Carotid Canal;
Vaginal process;
Styloid process, which gives attachment to the stylo-hyoid & -maxillary ligaments and from above downwards to the stylo-pharyngeus, -hyoideus & -glossus muscles:
Stylo-mastoid foramen for facial nerve & stylo-mastoid artery.

IN FRONT & on the OUTER SIDE of the DIAGONAL LINE

Are found from before backwards & outwards the
Foramen ovale for inferior maxillary & small petrosal nerves and small meningeal artery, and on inner side of which is sometimes found the
Foramen Vesalii for a small vein;
Foramen Spinosum for middle meningeal artery;
Spine of the Sphenoid for internal lateral ligament of jaw & laxator tympani m.
Openings of the canal for the tensor tympani muscle (above) & of the osseous portion of the Eustachian tube (below).
Glenoid fossa divided by Glaserian fissure into
Anterior part, covered with cartilage which latter is prolonged over the eminentia articularis;
Posterior part non articular, and bounded behind by the vaginal & auditory processes and the middle root of the zygoma.

BEHIND & on the INNER SIDE of the DIAGONAL LINE

Are the:
Jugular fossa for internal jugular vein. This fossa assists in forming the
Jugular foramen or Foramen Lacerum posterius, of which the
Anterior or inner part, smaller and separated from the remainder by a bony ridge, transmits anteriorly the inferior petrosal sinus, and posteriorly, the glosso-pharyngeal, pneumo-gastric & spinal accessory nerves, while the
Posterior part, the larger, transmits the internal jugular vein;
Jugular process for rectus capitis lateralis & lateral occipito-atloid ligament.
This process has in front of it & to its inner side the
Anterior condyloid foramen for hypoglossal nerve; behind it & to its inner side the
Posterior condyloid fossa sometimes perforated by *posterior condyloid foramen* for a small vein to lateral sinus.
Openings for Jacobson's & Arnold's nerves, and opening of Aqueductus Cochleæ

INNER SURFACE of BASE of SKULL.

Presents three fossæ.

ANTERIOR FOSSA — The highest.

Formed by orbital plates of frontal, cribriform plate of ethmoid, lesser wings and front part of upper surface of body of sphenoid.

Presents the sutures between the foregoing bones, and in median line and from above downwards and then backwards:

Front part of groove for superior longitudinal sinus,
Frontal crest,
Foramen cæcum,
Crista galli,
A slightly elevated ridge.

On the side of the two latter is the

Olfactory groove deep in front, where it is formed by cribriform plate of ethmoid, and presents

Three rows of foramina for olfactory nerves,
Slit-like opening for nasal nerve,
Anterior & posterior ethmoidal foramina for nasal nerve and anterior & posterior ethmoidal arteries.

MIDDLE FOSSA — Vide next Tablet.

POSTERIOR FOSSA — The deepest.

Formed by occipital, petrous & mastoid portions of temporal and posterior inferior angle of parietal, and bounded in front by dorsum sellæ & superior border of petrous bones, and behind, by grooves for lateral sinuses.

Presents the sutures between the foregoing bones, and in the centre:

Foramen magnum for cord and its membranes, spinal accessory nerves & vertebral arteries.

In Front of the Foramen Magnum is the

Basilar groove, which supports medulla oblongata & pons, and on the sides of which are the *petro-occipital sutures,* which are grooved in front for inferior petrosal sinuses and expanded behind into jugular foramen or foramen lacerum posterius.

Behind the Foramen Magnum is the

Internal occipital crest, which separates the two
Inferior occipital fossæ, and ends in the
Internal occipital protuberance, which is situated at point of junction of the
Grooves for lateral sinuses, and to which corresponds the torcular Herophili.

On the Sides of Foramen Magnum are the

Anterior condyloid foramina for hypoglossal nerves, and, occasionally, the
Posterior condyloid foramina for a small vein to lateral sinus;
Jugular foramen or foramen lacerum posterius, of which the
Anterior or inner part, smaller and separated from the remainder by a bony ridge, transmits anteriorly the inferior petrosal sinus, and posteriorly the glosso-pharyngeal, pneumogastric & spinal accessory nerves, while the
Posterior part, larger, transmits the internal jugular vein;
Posterior surface of petrous portion of temporal bone presenting
Internal auditory meatus for facial nerve and auditory artery & n.,
Slit-like aperture of Aqueductus Vestibuli for small artery & vein and a process of dura mater.

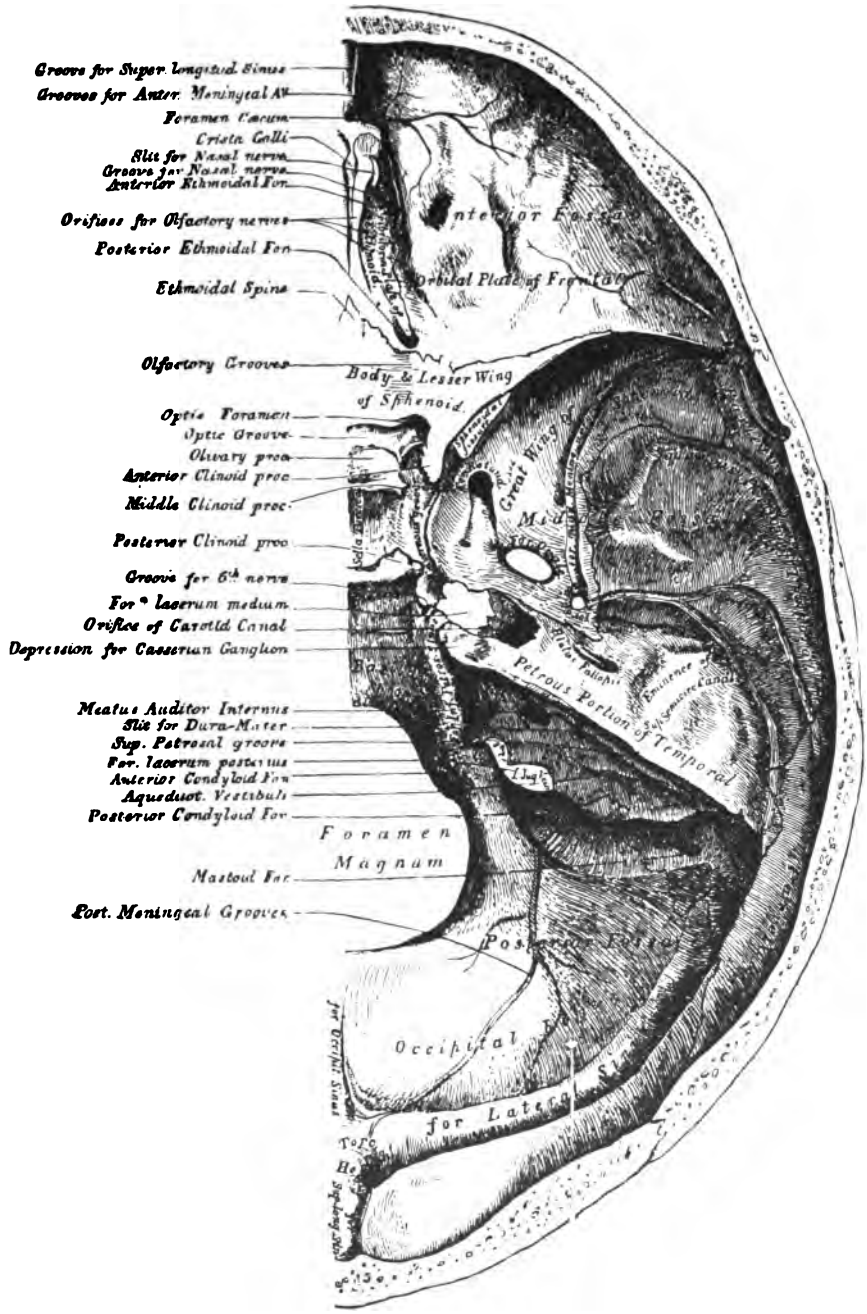


FIG. 70.—BASE OF SKULL. INNER SURFACE. (Gray.)

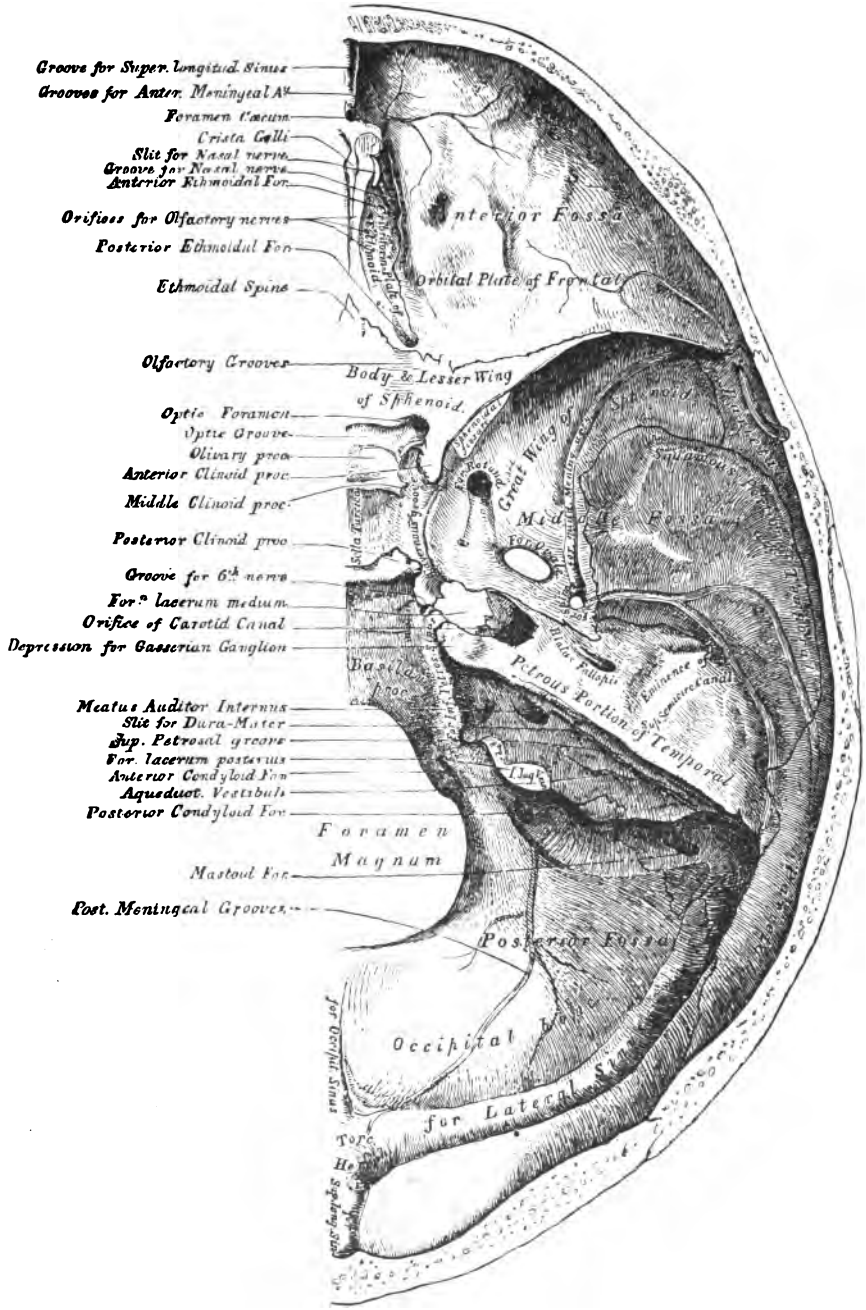


FIG. 80.—BASE OF SKULL. INNER SURFACE. (Gray.)

MIDDLE FOSSA of BASE of SKULL.

Is narrow in median line & expanded laterally.

Is formed by body & greater wings of sphenoid, squamous portion and anterior surface of petrous portion of temporal and anterior inferior angle of parietal, and is bounded by lesser wings of sphenoid & anterior margin of optic groove, in front, and by superior border of petrous bones behind.

Presents the sutures between foregoing bones and

In Median Line from before backwards:

Optic groove leading on either side to
Optic foramen for optic nerve & ophthalmic artery,
Olivary process,
Sella turcica on each side of which is the
Cavernous groove,
Dorsum sellæ presenting at its upper angles the
Posterior clinoid processes.

Laterally:

Cerebral eminences & depressions, and *grooves* for middle meningeal artery; and more internally, and from before backwards:
Sphenoidal fissure or foramen lacerum anterius for 3rd, 4th & 6th nerves, and ophthalmic nerve & vein,
Foramen rotundum for superior maxillary nerve,
Foramen ovale for inferior maxillary & small superficial petrosal nerves and small meningeal artery, (on inner side of which latter foramen is sometimes seen
Foramen Vesalii for a small vein),
Foramen spinosum for middle meningeal artery,
Foramen lacerum medium closed with cartilage.

On Anterior Surface of Petrous Bone:

Internal orifice of carotid canal,
Depression for Gasserian ganglion,
Grooves to Hiatus Fallopii for large superficial petrosal nerve and to a smaller and more external opening for small superficial petrosal nerve; frequently
Two other small foramina for small petrosal branch of glosso-pharyngeal and branch of glosso-pharyngeal to large superficial petrosal nerve,
Eminence corresponding to superior semi-circular canal, on outer side of which is a
Depression corresponding to cavity of tympanum.

LATERAL REGION of the SKULL.

Presents from behind forwards the:
Mastoid process;
Ext. auditory meatus;
Zygomatic arch & ramus of the jaw, which two latter arch over the temporal, zygomatic & spheno-maxillary fossæ.

TEMPORAL FOSSA

Is formed by the temporal, frontal, & malar bones, the great wing of the sphenoid, & the anterior inferior angle of the parietal, and **is deeply excavated** below & in front.
Is bounded above by the temporal ridge, and opens widely below into the zygomatic fossa, the boundary line between the two being the zygomatic arch & the pterygoid ridge.

ZYGOMATIC FOSSA

Is an irregular and imperfectly enclosed space, the incomplete walls of which are formed on the anterior, inner, upper & outer aspects respectively by the
Tuberosity of the sup. maxillary bone,
Ext. pterygoid plate,
Under surface of great wing of sphenoid as far as pterygoid ridge, and *squamous portion of temporal bone.*
Zygomatic arch & ramus of lower jaw.
Communicates with temporal fossa beneath the zygoma, and with the orbit & spheno-maxillary fossæ through the spheno-maxillary & pterygo-maxillary fissures.

Spheno-Maxillary Fissure – Is bounded by superior maxillary, great wing of sphenoid, malar & palate bones, aud joins internally at right angles with pterygo-maxillary fissure.
Opens up communications between the orbit and the temporal, zygomatic & spheno-maxillary fossæ.
Transmits infraorbital artery, superior maxillary nerve & ascending or orbital branches of Meckel's ganglion.

Pterygo-Maxillary Fissure – Is comprised between pterygoid process & tuberosity of superior maxillary bone.
Joins superiorly at right angles with spheno-maxillary fissure.
Transmits internal maxillary artery from zygomatic to spheno-maxillary fossa.

SPHENO-MAXILLARY FOSSA — Is the narrow & vertically elongated space comprised between the pterygoid process & the maxillary tuberosity, and bounded above & internally by the body of the sphenoid & the vertical plate of the palate bone.
Its upper part is the point of meeting of the sphenoidal, spheno-maxillary & pterygo-maxillary fissures.
It communicates with the cranium, orbit, zygomatic & nasal fossæ by the foramen rotundum & spheno- & pterygo-maxillary fissures & the spheno-palatine foramen, and has, opening into it, the vidian, pterygo-palatine, posterior palatine & accessory posterior palatine canals.

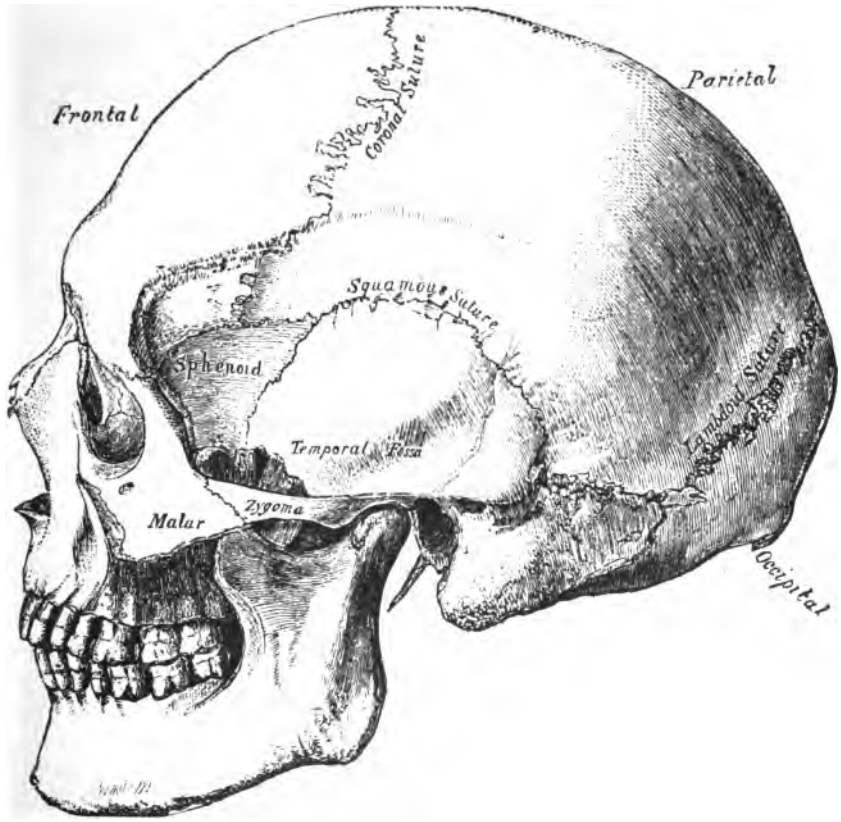


FIG. 81.—SIDE VIEW OF THE SKULL. (Gray.)

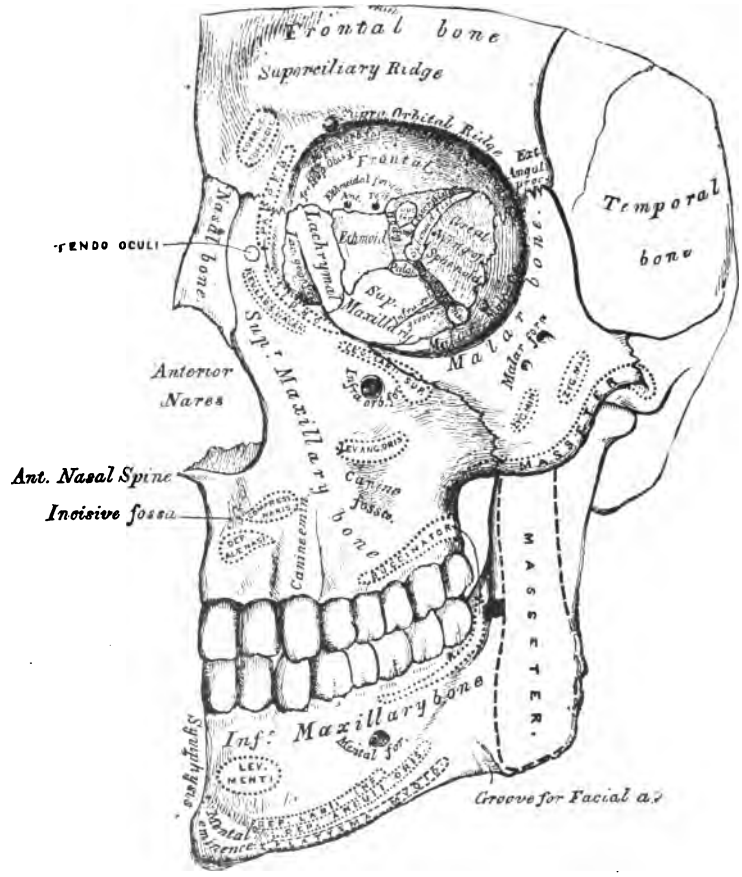


FIG. 82.—ANTERIOR REGION OF THE SKULL (Gray.)

(*See also Fig.* 88, *p.* 84.)

THE ORBIT.

Quadrilateral pyramidal fossa looking forwards & outwards and formed by seven bones, the frontal, ethmoid, sphenoid (which enter into formation of both orbits), superior maxillary, malar, lachrymal & palate.

Communicates with cranium, and with nasal, temporal, zygomatic & spheno-maxillary fossæ through optic foramen, nasal duct & spheno-maxillary fissure.

Presents:

ROOF — Formed by orbital plate of frontal & lesser wing of sphenoid. Is concave, and presents the suture between the foregoing bones, and in front the

Lachrymal fossa for lachrymal gland, and a

Depression (fovea trochlearis) for pulley of superior oblique.

FLOOR — Formed by upper or orbital surface of superior maxillary and orbital processes of malar & palate bones. Presents the sutures between foregoing bones, the

Infra-orbital groove for infra-orbital vessels & nerve, which becomes converted in front into *Infra-orbital canal;* and also at its anterior & inner part a

Depression for inferior oblique muscle.

INNER WALL — Formed from before backwards by nasal process of superior maxillary, lachrymal, os planum of ethmoid, body of sphenoid. Is antero-posterior in direction and parallel to its fellow, and presents the sutures between foregoing bones and the

Lachrymal groove for lachrymal sac,

Crest of lachrymal bone for tensor tarsi muscle.

OUTER WALL — Formed in front by orbital process of malar bone, and behind by anterior or orbital surface of great wing of sphenoid. Is very oblique forwards & outwards being nearly at right angles with its fellow, and presents the suture between foregoing bones, and the

Orifices of one or two malar canals,

Small spine for lower head of external rectus.

ANGLES:

SUP. EXTERNAL – Presents:

Articulation of frontal with malar bone & orbital plate of sphenoid,

Sphenoidal fissure or *foramen lacerum anterius* for 3rd, 4th & 6th nerves and ophthalmic nerve & vein.

SUP. INTERNAL – Presents

Suture connecting frontal with lachrymal & os planum, in which suture are the *Anterior ethmoidal canal* for nasal nerve & anterior ethmoidal vessels, and the *Posterior ethmoidal canal* for posterior ethmoidal vessels.

INF. EXTERNAL – Presents

Spheno-maxillary fissure for infra-orbital vessels & nerve and ascending branches of Meckel's ganglion.

INF. INTERNAL – Presents

Articulation of superior maxillary & palate bones with lachrymal & os planum.

CIRCUMFERENCE OR BASE — Quadrilateral, looks forwards & outwards. Is bounded by supra-orbital arch and external & internal angular processes of frontal, anterior border of orbital surface & nasal process of superior maxillary, and anterior border of malar bone. Presents

Supra-orbital notch or foramen for supra-orbital vessels & nerve; and assists in forming *Lachrymal groove* for lachrymal sac.

APEX — Corresponds to optic foramen for optic nerve & ophthalmic artery.

THE NASAL FOSSÆ.

Two narrow irregular cavities comprised between the orbits & superior maxillary bones, and between the roof of the mouth & the front part of the base of the skull. Formed by ethmoid, sphenoid, frontal, superior maxillary, nasal, palate, inferior turbinated & vomer (all the bones of the face except malar & inferior maxillary). Communicate with orbit (nasal duct), mouth, (anterior palatine canal), cranium (olfactory foramina), spheno-maxillary fossa (spheno-palatine foramen), and with the frontal, ethmoidal, sphenoidal, & maxillary sinuses. – Present:

ROOF — Narrow, and is from before backwards:
Oblique upwards & backwards and formed by nasal bone & nasal spine of frontal,
Horizontal and formed by cribriform plate of ethmoid,
Oblique downwards & backwards and formed by body of sphenoid. – Presents the sutures between the foregoing bones and from before backwards:
Groove on nasal bone for outer branch of nasal nerve;
Half crest for perpendicular plate of ethmoid;
Olfactory foramina & nasal slit for olfactory and nasal nerves;
Openings of sphenoidal sinuses partly closed by sphenoidal turbinated bones;
Articulation of alæ of vomer with body of sphenoid.

FLOOR — Concave from side to side, and formed by palate processes of superior maxillary & palate bones. – Presents the suture between foregoing bones & the
Upper orifice of the anterior palatine canal;
Half crest for vomer, which terminates in front & behind in the
Anterior & posterior nasal spines.

INNER WALL — Formed principally by the perpendicular plate of the ethmoid above & in front, and by the vomer below & behind, and secondarily by nasal spine of the frontal, rostrum of sphenoid, crests of superior maxillary, nasal & palate bones. Has an angular deficiency in front which is filled up by the cartilage of the septum. – Is frequently inclined to one or other side; and presents the sutures between the foregoing bones and
Vascular & nervous furrows &
Naso-palatine groove for naso-palatine nerve.

OUTER WALL — Formed by:
Lachrymal bone & nasal process of superior maxillary;
Inner surface of ethmoid, superior maxillary & inferior turbinated bones;
Vertical plate of palate bone & inner plate of pterygoid process. – Presents the sutures between the foregoing bones and from above downwards:
Superior turbinated process of ethmoid;
Superior meatus, into which open the sphenoidal & posterior ethmoidal sinuses and the spheno-palatine foramen. – Both are short and are situated at the posterior and upper part of the nares;
Middle turbinated process of ethmoid;
Middle meatus, larger than foregoing, into which open the Antrum of Highmore and through the infundibulum, the anterior ethmoidal cells & frontal sinuses;
Inferior turbinated bone;
Inferior meatus, the largest, presents in front the opening of the nasal duct.

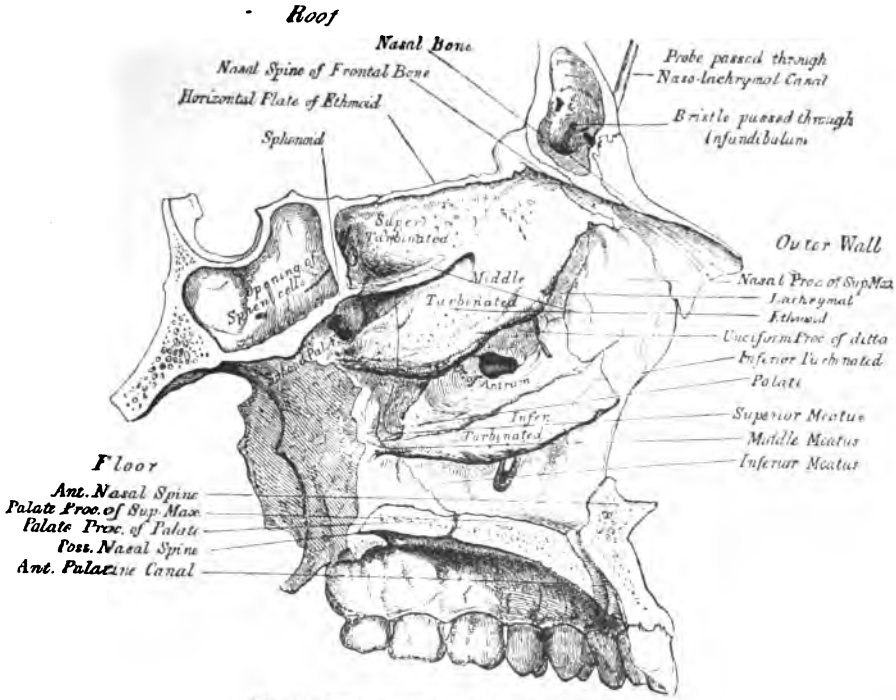


FIG. 83.—ROOF, FLOOR, AND OUTER WALL OF LEFT NASAL FOSSA. (GRAY.)

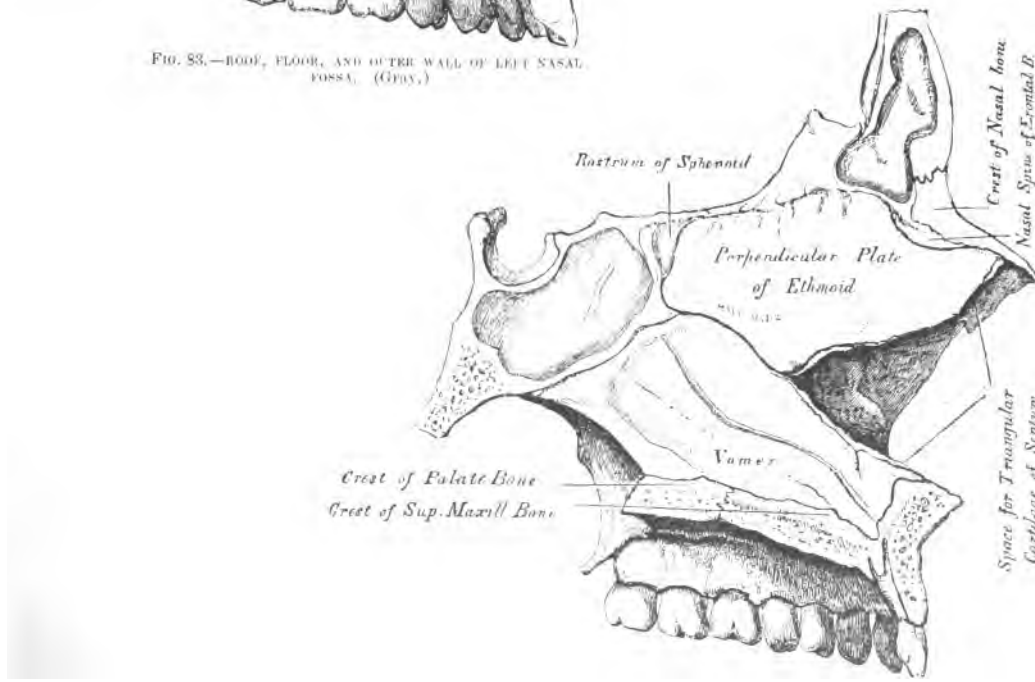

Rostrum of Sphenoid
Crest of Nasal bone
Nasal Spine of Frontal B.
Perpendicular Plate of Ethmoid
Vomer
Crest of Palate Bone
Crest of Sup. Maxill Bone
Space for Triangular Cartilage of Septum

FIG 84.—INNER WALL OF NASAL FOSSA (Gray.)

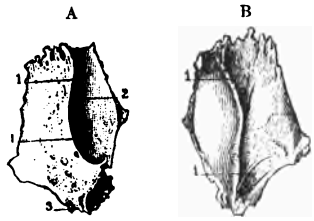


FIG. 85.—THE RIGHT LACHRYMAL BONE, ENLARGED: A, OUTER SURFACE; B, INNER SURFACE.

1, ridge on outer surface; corresponding furrow on inner surface; 2, groove forming part of nasal duct; 3, hamulus lachrymalis. Sappey.)

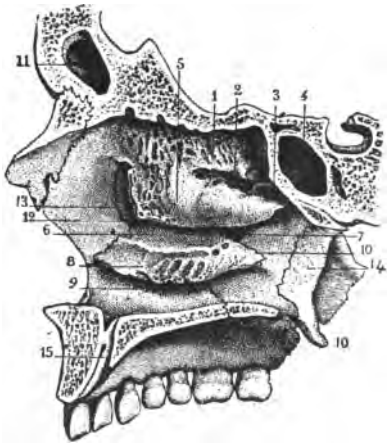


FIG. 86.—THE OUTER WALL OF THE NASAL FOSSA.

1, superior turbinated process of the ethmoid; 2, superior meatus; 3, spheno-palatine foramen; 4, sphenoidal sinus; 5, middle turbinated process of ethmoid; 6, middle meatus; 7, opening of the antrum of Highmore; 8, inferior turbinated bone; 9, inferior meatus; 10, hamular process; 11, frontal sinus; 12, nasal process of superior maxilla; 13, lachrymal bone; 14, inner plate of pterygoid process of sphenoid; 15, anterior palatine canal. (Sappey.)

FIG. 87.—THE INNER WALL OF THE NASAL FOSSA.

1, perpendicular plate of the ethmoid; 2, vomer; 4, frontal sinus; 5, anterior palatine canal. (Sappey.)

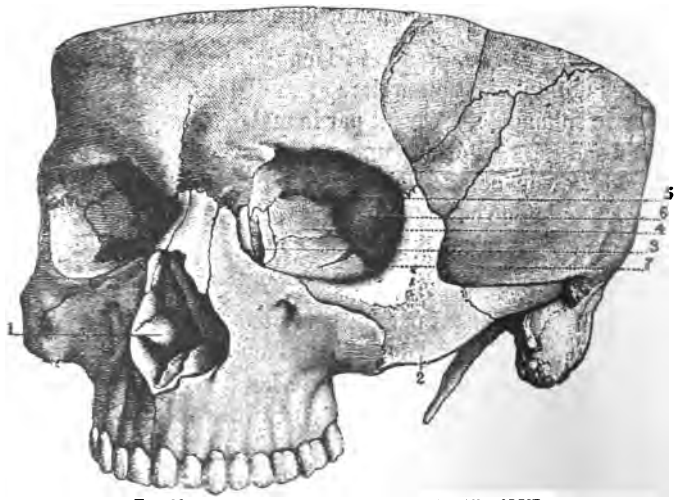


FIG. 88.—ANTERO-LATERAL VIEW OF SKULL AND ORBIT.

3, lachrymal bone; 4, os planum of ethmoid; 5, optic foramen, a little in front of which there are seen the anterior & posterior ethmoidal foramina; 6, sphenoidal fissure; 7, spheno-maxillary fissure; 1, inferior turbinated bone; 2, malar bone. (Sappey.)

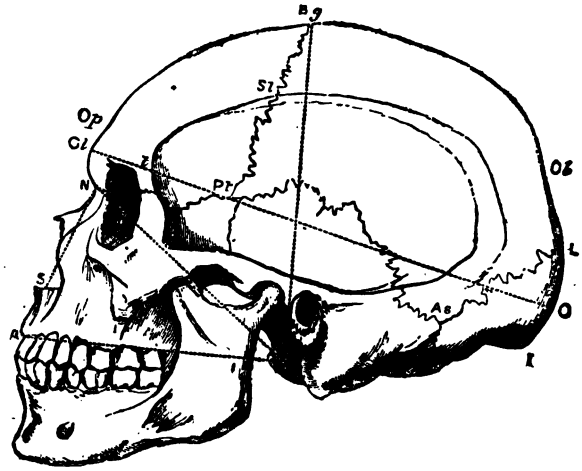


FIG. 89.—PRINCIPAL "CRANIAL POINTS AND LINES." (Quain.)

CRANIAL TOPOGRAPHY.

The first half of the important subject of cranio-cerebral topography may be briefly referred to here; the brain-levels, and the lines of the cerebral fissures, sinuses, &c., will be taken in Part III. with the study of the brain.

1.—MEDIAN POINTS, FROM FRONT TO BACK.

Alveolar Point (A.).—Centre of superior alveolar arch, or interval between central incisor teeth of upper jaw.

Subnasal Point (S.).—The conjoined anterior nasal spines of the superior maxillæ, or inferior mesial point of anterior aperture of nares.

Nasion (N.).—Middle of fronto-nasal suture.

Glabella (Gl.).—Most prominent point of nasal eminence.

Ophryon (Op.).—Middle of line drawn across narrowest part of forehead and separating face from cranium.

Bregma (Bg.)—Junction of coronal and sagittal sutures.

Obelion (Ob.).—Region between the two parietal foramina, whera sagittal suture is simplest, and where its closure usually commences.

Lambda (L.).—Junction of sagittal and lambdoid sutures.

Occipital Point (O.).—Median point of occipital bone farthest removed from glabella.

Inion (I.).—External occipital protuberance.

Opisthion.—Middle of posterior margin of foramen magnum.

Basion (B.).—Middle of anterior margin of foramen magnum.

2.—BILATERAL POINTS.

Pterion (Pt.).—Point of meeting, near anterior part of temporal fossa, of frontal,

anterior inferior angle of parietal, squamous portion of temporal, and greater wing of sphenoid, – the precise disposition varying considerably

Stephanion (St.).—Point where temporal ridge crosses coronal suture

Asterion (As.).—Point of junction of lambdoid, parieto-mastoid, and occipito-mastoid sutures.

Auricular Point.—Centre of external auditory meatus.

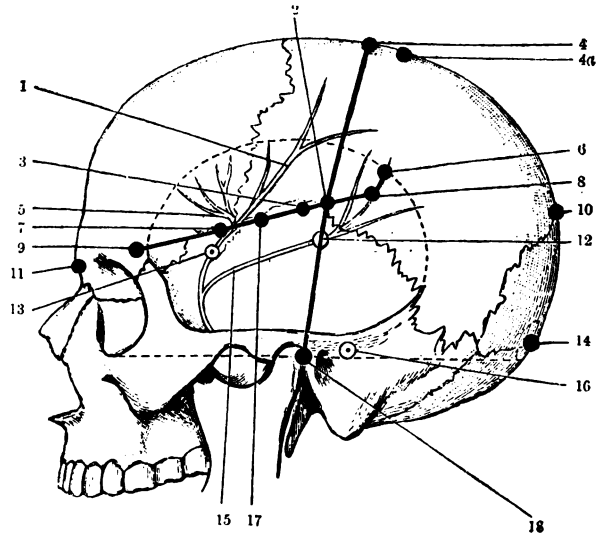


FIG. 90.—ADDITIONAL "CRANIAL POINTS AND LINES." (Anderson & Makins; from Heath's Anatomy.)

Some additional or substitutional points and lines are introduced by Mr. William Anderson and Mr. Makins, as follows :—

Mid-sagittal Point (4.).—Midway between the glabella and the inion.

Pre-auricular Point (18.).—In front of tragus, on a level with upper border of external auditory meatus

Frontal Line.—From pre-auricular point to mid-sagittal point.

Squamosal Point (2.). On frontal line, midway between pre-auricular and mid-sagittal points.

Angular Point (9.).—Over external angular process of frontal bone, on a level with upper border of orbit.

Squamosal Line—From angular point to squamosal point

BONES OF THE UPPER LIMB

THE SCAPULA—1st Tablet.

Large, flat, triangular, situated at back of shoulder, and presents two surfaces, three borders, three angles.

ANTERIOR SURFACE or VENTER — Concave; forms subscapular fossa, which fossa is deepest at upper & outer part, and presents from within outwards:
narrow marginal surface for serratus magnus, which surface becomes broader & triangular opposite the superior & inferior angles;
rough oblique ridges converging upwards & outwards for tendinous intersections of subscapularis;
rounded prominent ridge descending from neck of scapula;
deep vertical groove for lower part of subscapularis.

POSTERIOR SURFACE or DORSUM — Divided by spine into:

SUPRASPINOUS FOSSA – The smaller, smooth, broadest internally, for supraspinatus.
INFRASPINOUS FOSSA – The larger, slightly convex towards middle, concave on either side. Presents internally a few
oblique ridges for tendinous intersections of infraspinatus, and externally a rough aponeurotic
ridge, which cuts off a
prominent marginal surface divided in two by an oblique line & crossed by a groove for dorsalis scapulæ artery, which surface gives origin in its narrow upper two-thirds, to the teres minor, and in its lower & broader third, to the teres major & occasionally to some of the fibres of the latissimus dorsi.

The Spine – Is a prominent triangular plate, which crosses obliquely the dorsum of the scapula towards its upper part, and which is continued into the acromion. It presents:

SURFACES:
Upper & Lower – Concave, forming part respectively of the supra- & infra-spinous fossæ.

BORDERS:
Anterior – Continuous with the remainder of the bone.
Posterior – Broad & thick. Commences internally by a triangular smooth surface covered by tendon of insertion of trapezius; gives attachment externally to this surface, to trapezius by its upper lip, to deltoid by its lower lip.
External – Concave, rounded; lost above upon under surface of acromion, below upon neck of scapula.

Acromion Process – Overhangs glenoid cavity, and is flattened & somewhat triangular. It presents:

SURFACES:
Superior – Rough for attachment of deltoid & trapezius.
Inferior – Concave & smooth, separated by a bursa from capsule of shoulder joint.

BORDERS:
Outer & Inner – For deltoid & trapezius, the latter presenting a small oval facet for clavicle.

Apex – Gives attachment to the coraco-acromial ligament.

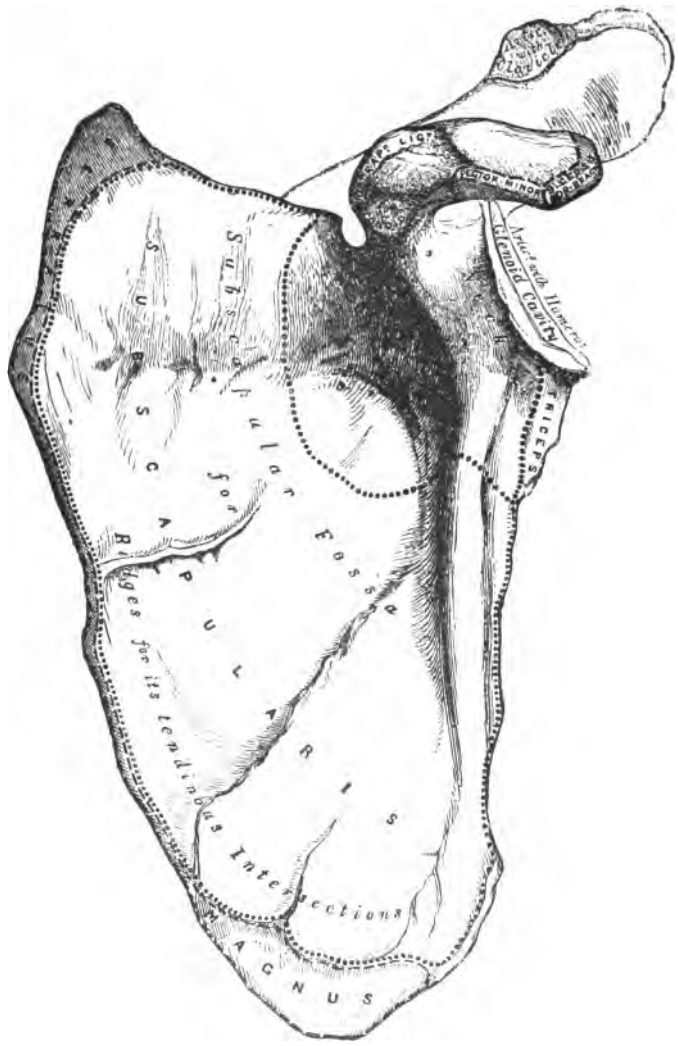


FIG. 91.—LEFT SCAPULA. ANTERIOR SURFACE, OR VENTER. (Gray)

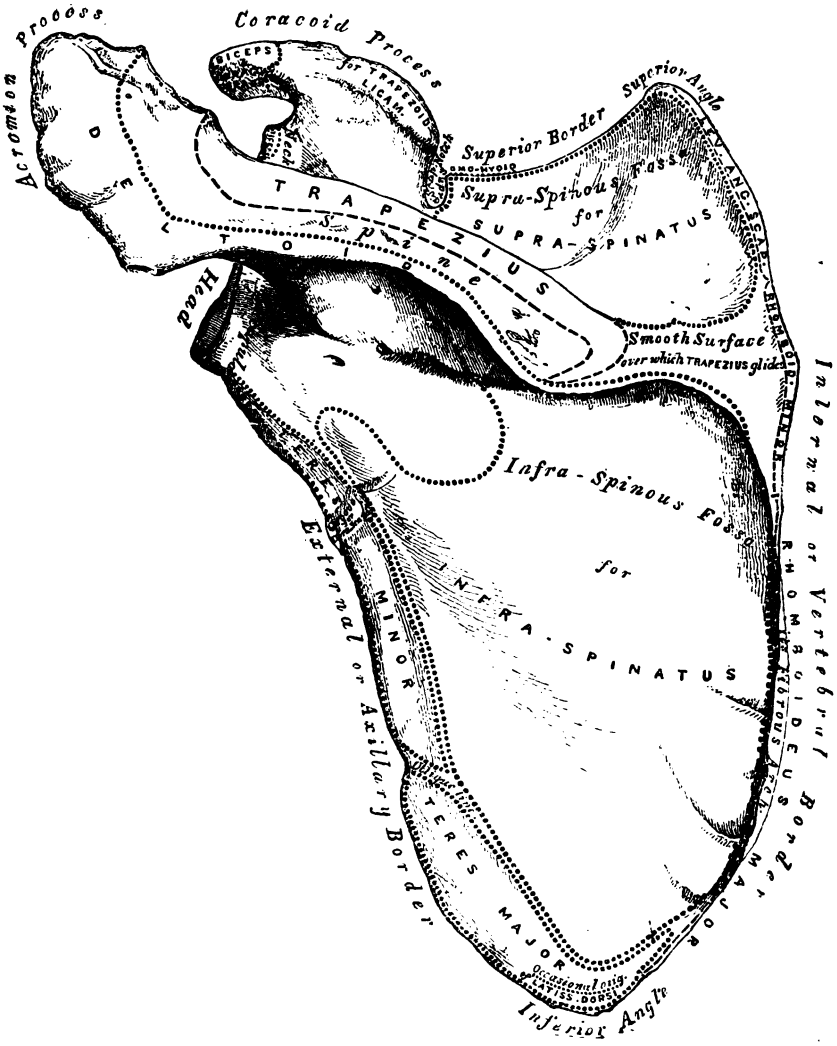


FIG. 92.—LEFT SCAPULA. POSTERIOR SURFACE, OR DORSUM. (Gray.)

THE SCAPULA—2nd Tablet.

BORDERS — Three:

Superior – The shortest & thinnest. Presents externally the *suprascapular notch* converted by the transverse ligament into a foramen for suprascapular nerve; – and gives origin just internally to this notch to the omo-hyoid muscle.

External or Axillary – The thickest. Presents just below glenoid cavity a *rough depression* for long head of triceps, and below this the *vertical groove* above mentioned for lower part of subscapularis.

Internal or Vertebral, or Base – The longest, thin, prominent opposite root of spine. Presents:
anterior lip for serratus magnus;
posterior lip for supra- & infraspinati;
interspace for levator anguli scapulæ, rhomboideus minor, and aponeurosis & fibrous arch of rhomboideus major.

ANGLES — Three:

Superior – Thin, prominent, for a few fibres of the levator anguli scapulæ & supraspinatus, and the two first digitations of the serratus magnus.

Inferior – Thick, rounded; gives attachment posteriorly to the teres major & occasionally to some of the fibres of the latissimus dorsi, and anteriorly to the four lower digitations of the serratus magnus.

Anterior or External – Forms the head & the neck of the scapula.

HEAD — Presents the

GLENOID CAVITY – Oval with longest diameter vertical, and with broad inferior & narrow superior extremities, the latter giving attachment to the tendon of the long head of the biceps; small & shallow, but slightly deepened & enlarged by glenoid ligament, which ligament is attached to the prominent margin of the cavity.

NECK — Flattened from before backwards, and most distinct behind. Is surmounted by the

CORACOID PROCESS – First thick & broad, and passes upwards & inwards, being flattened from before backwards, and presenting internally a rough depression for conoid ligament. It then becomes smaller, passes forwards & outwards, and is flattened from above downwards; this terminal portion presents:
under surface, smooth & concave;
upper surface with rough oblique ridge for trapezoid ligament;
anterior or inner border for pectoralis minor;
posterior border for coraco-acromial ligament;
apex for common tendon of coraco-brachialis & of short head of biceps.

THE CLAVICLE

Is usually reckoned as a long bone, though, structurally, it rather resembles a short bone. It is curved like an italic *ſ* and is convex anteriorly & rounded in its inner two-thirds, concave anteriorly and flattened from above downwards, in its outer third.

INNER or CYLINDRICAL PORTION — Presents three borders and three surfaces.

Borders – Are:

ANTERIOR – Continuous with anterior border of flattened portion, and gives attachment to pectoralis major.

POSTERIOR – Extends from rhomboid impression to conoid tubercle, and forms posterior boundary of subclavian groove.

SUPERIOR – Continuous with posterior border of flattened portion, and gives attachment to sterno-mastoid.

Surfaces – Are:

ANTERIOR – Convex & continuous with upper surface of flattened portion. Is covered externally by platysma, and gives attachment internally to sterno-mastoid & pectoralis major.

POSTERIOR – Concave, narrow externally, where it becomes continuous with posterior border of flattened portion. Frequently gives origin internally to some of the fibres of the sterno-cleido-hyoid, and presents towards its middle the nutrient canal, which is directed outwards.

INFERIOR – Narrow internally; broader externally, where it becomes continuous with under surface of flattened portion. Presents from within outwards:

Articular facet, which articulates with cartilage of first rib, and which is continuous with sternal articular surface;

Rhomboid impression for rhomboid or costo-clavicular ligament;

Subclavian groove for subclavius muscle.

OUTER or FLATTENED PORTION — Presents:

Borders:

ANTERIOR – Thin, concave, for deltoid.

POSTERIOR – Thicker, convex, for trapezius.

Surfaces:

SUPERIOR – Rough, for deltoid & trapezius.

INFERIOR – Presents internally

Conoid tubercle for conoid ligament, from which tubercle passes forwards & outwards the

Oblique line for trapezoid ligament.

INNER or STERNAL END — Enlarged & triangular. Its articular facet is continuous with the costal facet at inner extremity of inferior surface. It is concave from before backwards and convex from above downwards & outwards; it gives attachment at its upper & back part to the interarticular fibro-cartilage of the sterno-clavicular articulation. – The circumference of the end of the bone, is rough for the anterior & posterior sterno-clavicular & the interclavicular ligaments.

OUTER or ACROMIAL END — Flattened from above downwards. Presents a small oval facet, which looks downwards & outwards and articulates with acromion. – The circumference of the end of the bone is rough for the superior & inferior acromio-clavicular ligaments.

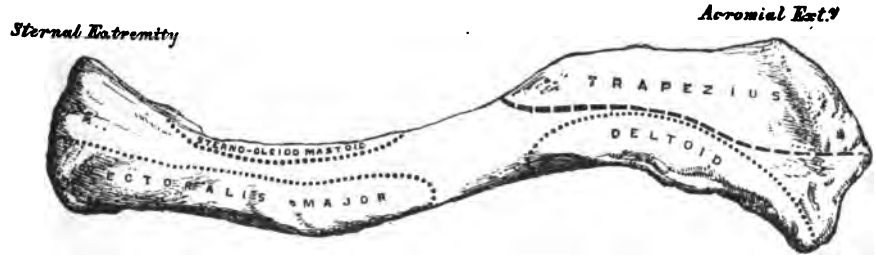


FIG. 93.—LEFT CLAVICLE. ANTERIOR SURFACE. (Gray.)

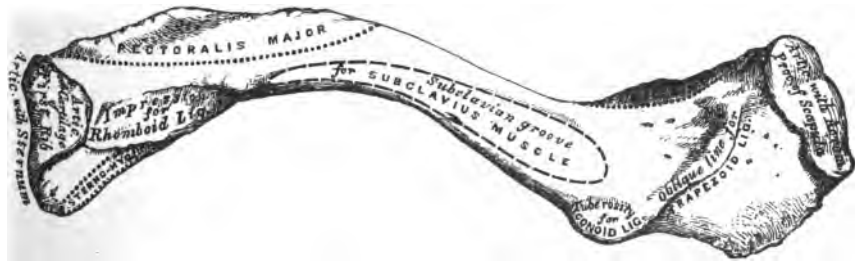


FIG. 94.—LEFT CLAVICLE. INFERIOR SURFACE. (Gray.)

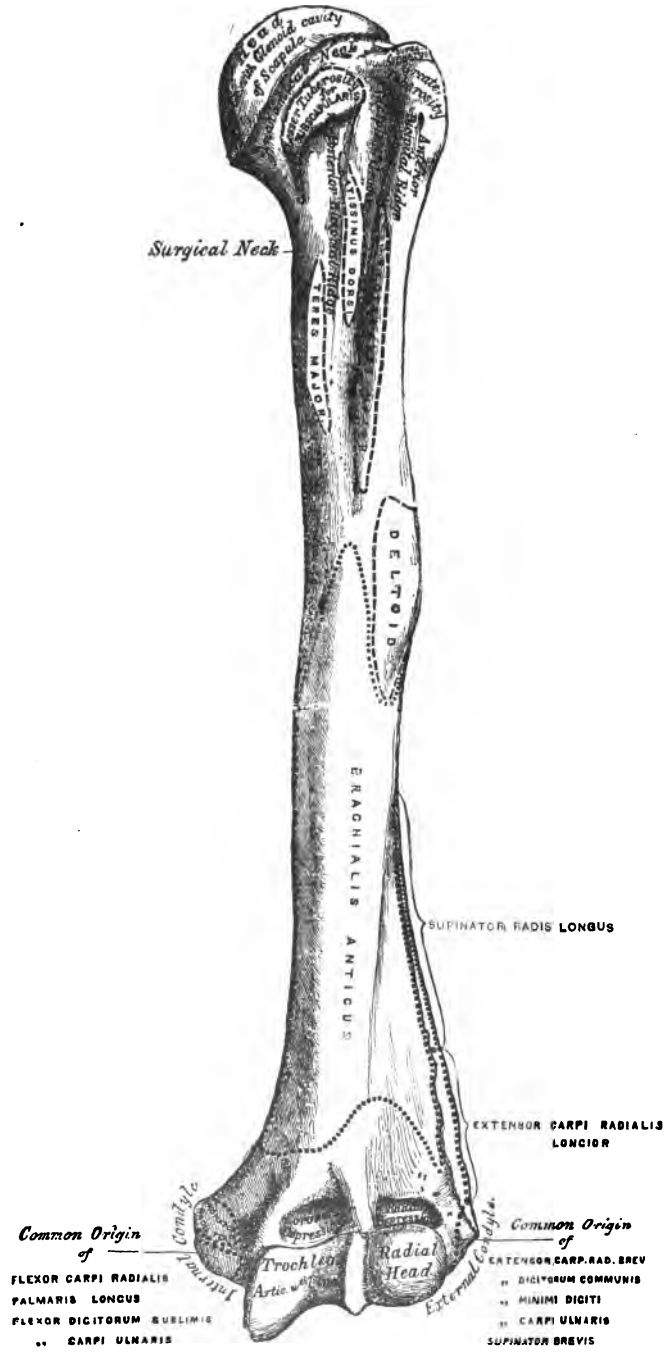


FIG. 95.—LEFT HUMERUS. ANTERIOR VIEW. (Gray)

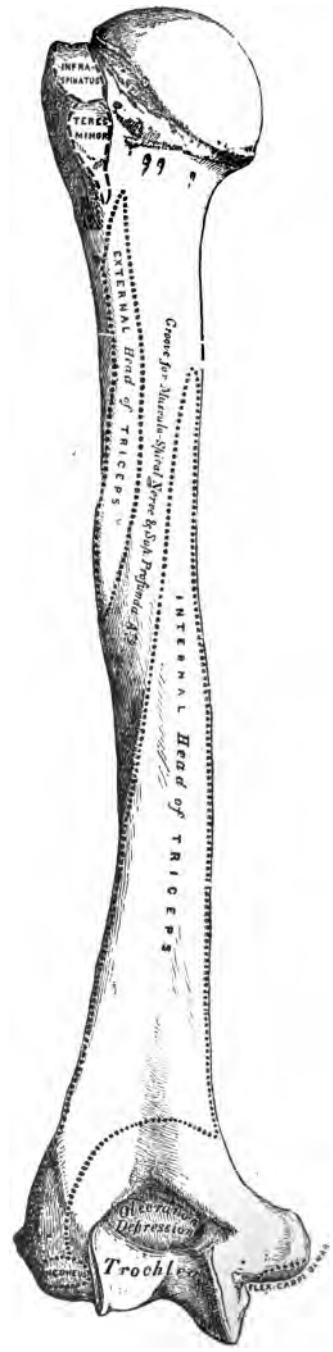


FIG. 96.—LEFT HUMERUS. POSTERIOR VIEW. (Gray.)

THE HUMERUS

Presents upper & lower extremities and a shaft.

UPPER EXTREMITY — Presents head, anatomical & surgical necks, greater & lesser tuberosities, and bicipital groove.

HEAD – Represents nearly one half of a sphere, and is much more extensive than the glenoid cavity, or corresponding articular surface of the scapula. It looks upwards, inwards & backwards, and is bounded by the

ANATOMICAL NECK – A slight circular constriction, rather irregular, which gives attachment to the capsule of the shoulder-joint.

GREATER TUBEROSITY – Large rounded eminence situated on the outer side of the bicipital groove. It presents from before backwards three small facets for supra- & infra-spinati & teres minor.

LESSER TUBEROSITY – Smaller, but more prominent, situated in front of the head, on the inner side of the bicipital groove. It gives attachment to the subscapularis.

BICIPITAL GROOVE – Corresponds to the upper third of the bone. It is deep & narrow above, where it separates the tuberosities, but it becomes broad & shallow below, where the tendon of the latissimus dorsi is inserted into it. It contains the long tendon of the biceps surrounded by a tubular prolongation of the synovial membrane of the shoulder-joint, and is covered with a thin layer of cartilage. Its anterior or outer lip gives attachment to the pectoralis major, its posterior or inner lip, to the teres major.

SURGICAL NECK – Is the slightly constricted part which joins upper extremity to shaft.

LOWER EXTREMITY — Is flattened from before backwards & slightly curved forwards. It presents an articular surface, and the inner and outer condyles.

Articular Surface – Extends a little lower than the condyles, and occupies a more anterior position. It is divided into:

RADIAL PORTION, HEAD, OR CAPITELLUM – Small rounded eminence limited to the front part of the bone. It is separated from the trochlear portion by a narrow groove for inner border of head of radius, and is surmounted by a slight depression which receives the anterior border of the same head when the fore-arm is completely flexed.

ULNAR OR TROCHLEAR PORTION – Extends also to the back of the bone. The inner border of the trochlea descends lower down than the outer one; the axis round which the ulna rotates is therefore directed downwards & inwards, and the plane of rotation downwards & outwards. – The trochlea is surmounted in front & behind by the coronoid & olecranon fossæ, which receive the corresponding processes in complete flexion, or complete extension, of the fore-arm. These fossæ are lined by the synovial membrane, and are separated by only a thin plate of bone; their margins give attachment to the anterior & posterior ligaments of the elbow-joint.

Inner Condyle – The most prominent & the highest. Gives attachment to the internal lateral ligament of the elbow-joint, & to the pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris & flexor sublimis digitorum muscles.

External Condyle – The lowest & least prominent. Gives attachment to the external lateral ligament of the elbow-joint & to the extensores carpi radialis brevior, communis digitorum, minimi digiti & carpi ulnaris, and to the anconeus & supinator brevis muscles.

SHAFT — Cylindrical above; prismatic and flattened from before backwards, below. Presents three borders & three surfaces.

Surfaces – Are internal, external, & posterior; the two former becoming more or less anterior below, where all three are broader & better defined than above.

INTERNAL – Rather narrower than external. Presents towards its middle a rough impression for coraco-brachialis, and frequently towards its lower part, the supra-condyloid process of Struthers.

EXTERNAL – Rather broader. Presents towards its middle a rough triangular impression for deltoid, and gives attachment below to brachialis anticus.

POSTERIOR – Somewhat twisted. Is crossed obliquely downwards & outwards by musculo-spiral groove, and gives origin, above & below the groove, to the outer & inner heads of the triceps.

Borders – Are:

ANTERIOR – From front of great tuberosity to coronoid depression, forming, above, anterior or outer lip of bicipital groove for attachment of pectoralis major

INTERNAL – From lesser tuberosity to internal condyle, forming, above, inner or posterior lip of bicipital groove for attachment of teres major, and, below, internal condyloid ridge for internal intermuscular septum, pronator radii teres, inner head of triceps & brachialis anticus. Towards its middle is found the opening of the nutrient canal directed downwards.

EXTERNAL – From back of greater tuberosity to external condyle. Is indistinct and crossed by musculo-spiral groove, above; inferiorly it becomes prominent, and forms the external condyloid ridge for external intermuscular septum, supinator longus, extensor carpi radialis longior outer head of triceps & brachialis a

THE RADIUS

Is smaller & shorter than than the ulna, and is smaller above than below. Presents:

UPPER EXTREMITY — The smaller. Presents:

HEAD – Cylindrical laterally and cup-shaped above. The cup articulates with the capitellum of the humerus, and its inner & broader edge articulates with the groove between the capitellum & the trochlea. The inner & broader part of the cylindrical surface articulates with the lesser sigmoid cavity of the ulna, the outer narrower part plays upon the orbicular ligament.

NECK – Is the constricted & rounded portion, which supports the head. It presents posteriorly a slight ridge for supinator brevis.

TUBEROSITY – Lies at the lower, inner & front part of the neck. It is rough behind for insertion of biceps, and smooth in front, where it is covered by a bursa.

LOWER EXTREMITY — Large, thick, quadrilateral, and presents an inferior surface, articular, and four lateral surfaces, of which the inner one is also articular.

INF. ARTICULAR SURFACE – Triangular, concave, divided by a slight antero-posterior ridge into an outer, larger, triangular portion for scaphoid, and an inner, smaller, quadrilateral portion for semilunar.

INT. ARTICULAR SURFACE, OR SIGMOID CAVITY – Narrow, concave, articulates with head of ulna.

ANT. SURFACE – Excavated; gives attachment to pronator quadratus. Its lower prominent margin gives attachment to anterior ligament of wrist-joint.

EXT. SURFACE – Is prolonged downwards into the

Styloid Process – Thick & conical; gives attachment at its base to supinator longus, at its apex, to external lateral ligament of wrist-joint. On its outer surface is a

shallow groove, oblique downwards & forwards and divided into two by a slight ridge, which groove transmits the extensores ossis metacarpi & primi internodii pollicis, both of which are enclosed in one synovial sheath.

POST. SURFACE – Convex, gives attachment below to posterior ligament of wrist-joint, and presents from without inwards a

broad & shallow groove divided into two by a slight ridge, which groove transmits the extensores carpi radialis longior & brevior, both enclosed in one synovial sheath;

narrow & deep groove for extensor secundi internodii pollicis & a synovial sheath;

broad & shallow groove for extensores indicis & communis digitorum both enclosed in one synovial sheath;

half-groove completed internally by head of ulna, for extensor minimi digiti & a synovial sheath.

SHAFT — Slightly concave anteriorly, small & rounded above, larger & prismoid below. Presents:

Surfaces – Three:

ANTERIOR – Narrow & concave in upper three-fourths for flexor longus pollicis, broad & concave in lower fourth for pronator quadratus. Presents nutrient foramen a little above its middle.

POSTERIOR – Narrow & rounded above for supinator brevis; broad & convex below. Gives origin towards its middle, where it is rough & slightly concave, to extensor primi internodii pollicis & to some of the fibres of the extensor ossis metacarpi.

EXTERNAL – Rounded & convex. Gives attachment above to supinator brevis and presents towards its middle a rough impression for pronator radii teres.

Borders – Three:

ANTERIOR – From front of bicipital tuberosity to front of base of styloid process. Is prominent above, where it forms the *oblique line*, and gives attachment to the supinator brevis, flexor sublimis digitorum & flexor longus pollicis; is sharply marked below for pronator quadratus.

POSTERIOR – From back of neck to back of styloid process; is most distinct in its middle third.

INTERNAL – From back of tuberosity to sigmoid cavity, to embrace which it bifurcates inferiorly. Gives attachment to the interosseous ligament, and is sharpest towards its middle.

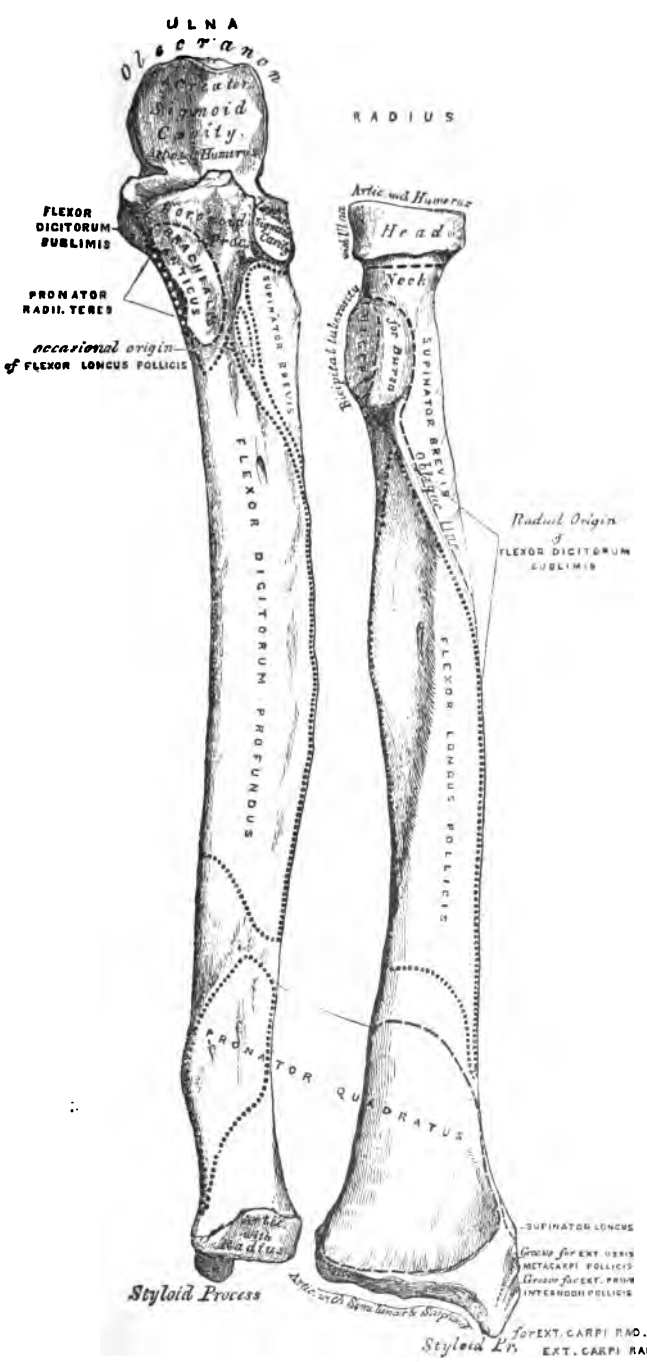


FIG. 97.—BONES OF LEFT FOREARM. ANTERIOR VIEW. (Gray.)

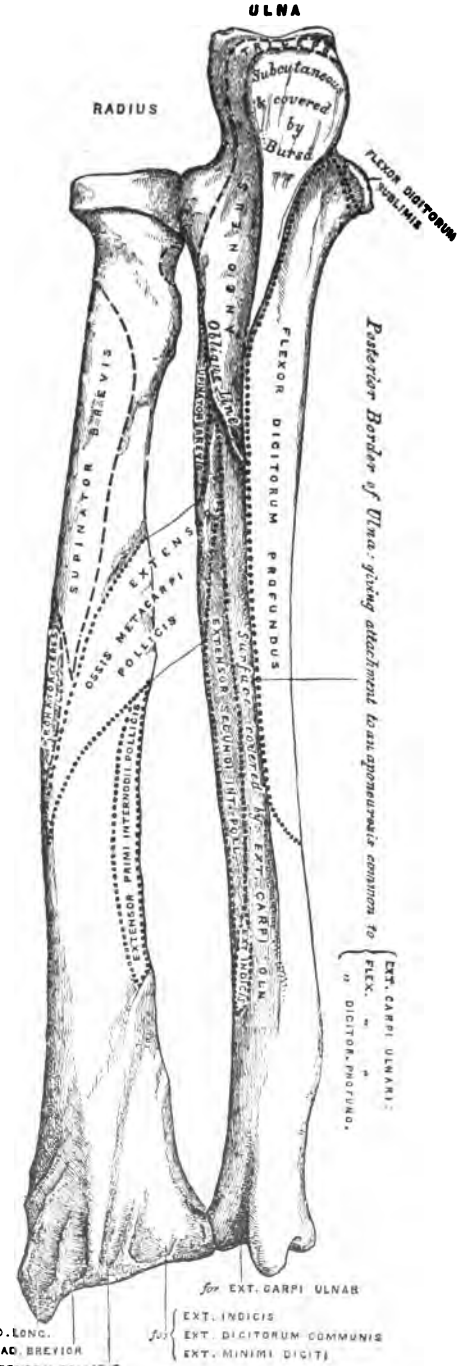


FIG. 98.—BONES OF LEFT FOREARM. POSTERIOR VIEW. (Gray.)

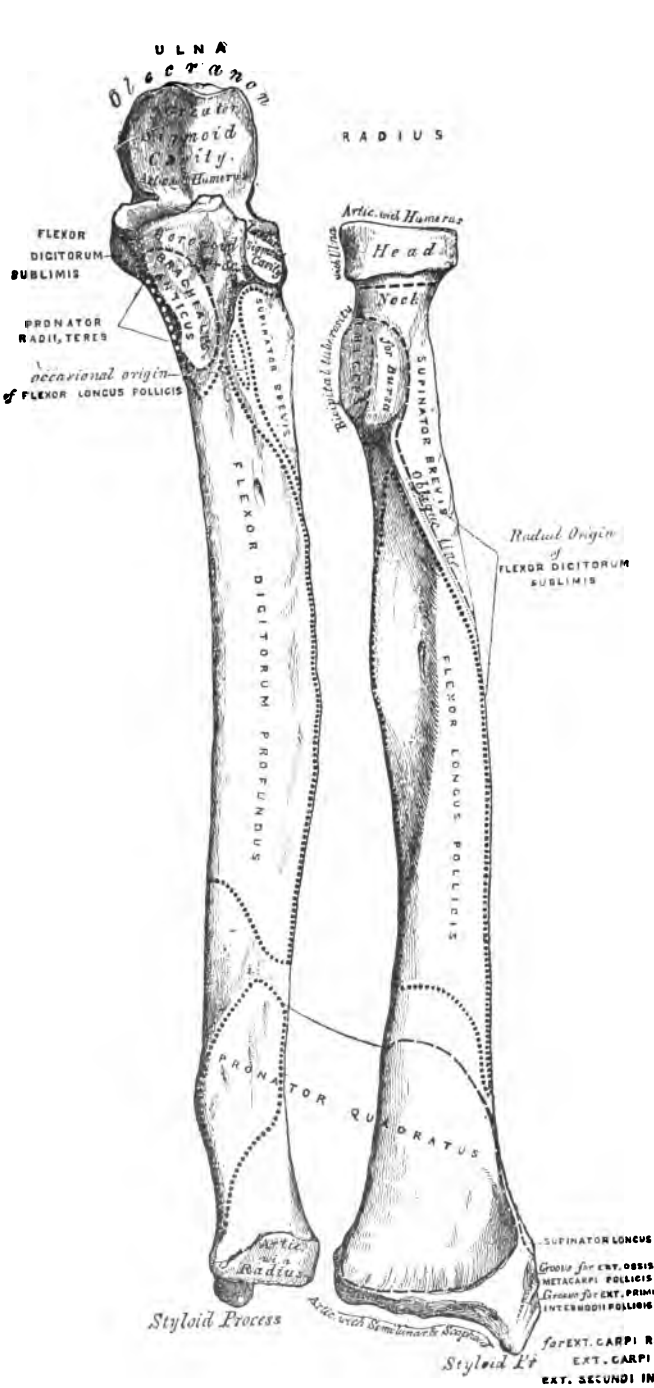


FIG. 99.—BONES OF LEFT FOREARM. ANTERIOR VIEW. (Gray.)

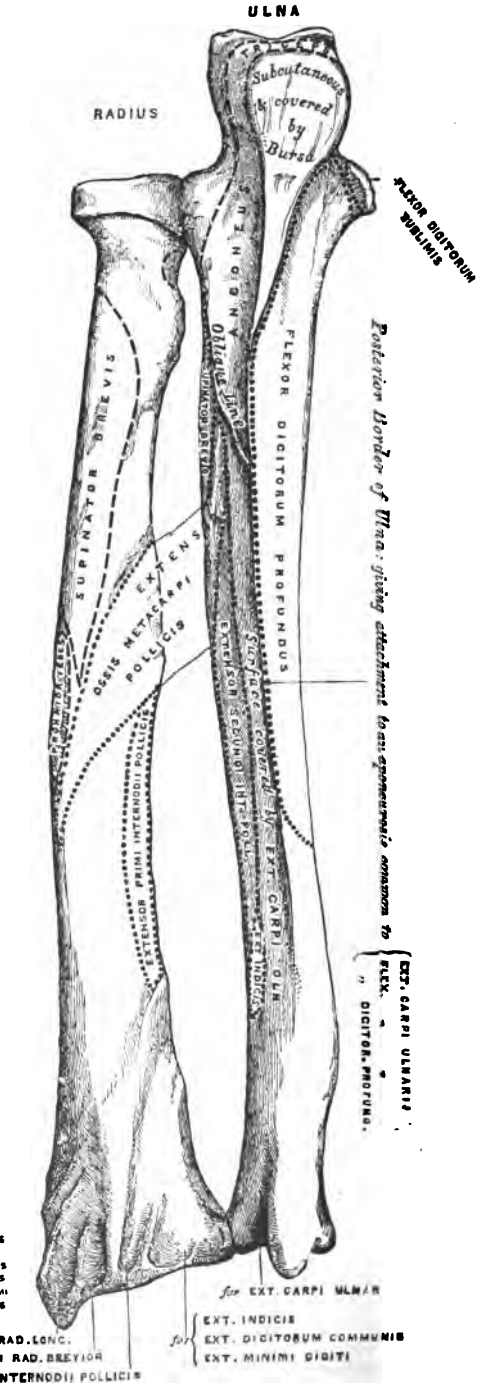


FIG. 100.—BONES OF LEFT FOREARM. POSTERIOR VIEW. (Gray.)

THE ULNA

Is larger & longer than the radius, and larger above than below. Presents:

UPPER EXTREMITY — The strongest part of the bone; presents the coronoid & olecranon processes, and the greater & lesser sigmoid cavities.

Coronoid Process – Prismatic. Projects forwards, and presents:

APEX – Slightly curved upwards; received into coronoid fossa in complete flexion of fore-arm;

BASE – Broad, continuous with shaft;

UPPER SURFACE – Articular, concave from before backwards, marked by a slight antero-posterior ridge.

UNDER SURFACE – Concave, rough for brachialis anticus & oblique ligament;

INNER SURFACE – Rough, concave behind for flexor profundus digitorum. Presents anteriorly & from above downwards:

prominent margin for internal lateral ligament of elbow-joint;

tubercle for middle head of flexor sublimis;

ridge for outer head of pronator radii teres. – A slip of the flexor longus pollicis arises sometimes from this surface.

OUTER SURFACE – Presents lesser sigmoid cavity above, and gives origin below to some of the fibres of the supinator brevis.

Olecranon Process – Large, slightly curved forwards. Presents:

APEX – Prominent, received into olecranon fossa in complete extension of forearm;

BASE – Contracted, continuous with shaft;

ANTERIOR SURFACE – Articular, concave, marked by a slight vertical ridge;

POSTERIOR SURFACE – Triangular, subcutaneous, covered by a bursa;

UPPER SURFACE – Rough behind for triceps; slightly grooved in front, close to margin, for posterior ligament of elbow-joint;

BORDERS, INNER & OUTER – Presenting continuation of same groove for internal & posterior ligaments.

Greater Sigmoid Cavity – Comprised between coronoid & olecranon processes, notched on either side towards its middle, and divided by a slightly elevated ridge into two parts, of which the internal is the broadest.

Lesser Sigmoid Cavity – Situated on outer side of coronoid process, narrow, concave from before backwards; its extremities give attachment to the orbicular ligament of the radius.

LOWER EXTREMITY — Small, excluded from wrist-joint by triangular fibro-cartilage. Presents:

HEAD – Articular below, where it is flattened and plays upon triangular fibro-cartilage, and externally, where it is semi-cylindrical and is received into sigmoid cavity of radius.

STYLOID PROCESS – Cylindrical, descends from inner & back part of head; gives attachment to internal lateral ligament of wrist-joint. – Between these parts there exists below, a

DEPRESSION – For attachment of triangular fibro-cartilage, and behind, a

GROOVE – Which transmits tendon of extensor carpi ulnaris.

SHAFT — Large & prismatic above, smaller & rounded below, slightly curved forwards, and convex externally above, internally below. Presents:

Surfaces – Anterior, posterior, internal, all three broader above than below.

ANTERIOR – Concave in upper three-fourths for flexor profundus digitorum, also excavated below for pronator quadratus. Presents the opening of the nutrient canal, which is directed upwards.

POSTERIOR – Presents above a triangular surface for anconeus, which surface is bounded externally by an oblique ridge for supinator brevis. Below this the posterior surface is divided by a vertical ridge into a narrow inner part, which gives attachment to, or is sometimes merely covered by, the extensor carpi ulnaris, and an outer broader part which gives attachment from above downwards to the supinator brevis and extensores ossis metacarpi pollicis, secundi internodii pollicis, & indicis.

INTERNAL – Gives attachment to the flexor profundus digitorum in its upper three-fourths; is subcutaneous in its lower fourth.

Borders – Anterior, posterior, external, best marked in upper two-thirds.

ANTERIOR – From ridge on inner surface of coronoid process to front of styloid process. Gives attachment to flexor profundus digitorum & pronator quadratus.

POSTERIOR – From lower & back part of olecranon to back of styloid process. Gives attachment superiorly to an aponeurosis common to flexor & extensor carpi ulnaris and flexor profundus digitorum.

EXTERNAL – Bifid superiorly, where it arises from either extremity of the lesser sigmoid cavity, and embraces a rough surface for supinator brevis; is very prominent towards middle; gives attachment to interosseous ligament.

BONES of the CARPUS — First Row.

SCAPHOID — Presents:

ANT. OR PALMAR SURFACE – Concave above; presents at its lower & outer part a tubercle for anterior annular ligament of carpus.

POST. OR DORSAL SURFACE – Is represented by a rough transverse groove for ligaments.

UPPER SURFACE – Is very oblique, and looks backwards & but slightly upwards; is convex & smooth, and articulates with radius.

UNDER SURFACE – Looks principally downwards, but also a little backwards & outwards. It presents two facets for trapezium & trapezoid.

OUTER SURFACE OR ANGLE – Small, rough, for external lateral ligament of wrist.

INNER SURFACE – Presents a superior small semilunar facet for semilunar, and an inferior large concave facet for os magnum.

SEMILUNAR — Presents:

ANT. & POST. SURFACES – Of which the former is the largest.

UPPER SURFACE – Convex; articulates with radius.

UNDER SURFACE – Concave; articulates with os magnum & os unciform.

OUTER SURFACE – Has a semilunar facet for scaphoid.

INNER SURFACE – Has a quadrilateral facet for cuneiform.

CUNEIFORM — Presents:

ANT. & POST. SURFACES – Of which the former is the smallest, and presents at its inner part an oval facet for pisiform.

UPPER SURFACE – Smooth in its outer part only, where it articulates with the triangular fibro-cartilage of the inferior radio-ulnar articulation.

UNDER SURFACE – Concave externally, convex internally; articulates with inner surface of unciform bone.

OUTER SURFACE – Has a quadrilateral facet for semilunar.

INNER SURFACE OR ANGLE – Small, rough, for internal lateral ligament of wrist.

PISIFORM — Presents:

ANT. SURFACE – Convex, for anterior annular ligament of carpus.

POST. SURFACE – At upper part of which is an oval articular facet for cuneiform.

OUTER SURFACE – Convex.

INNER SURFACE – Concave.

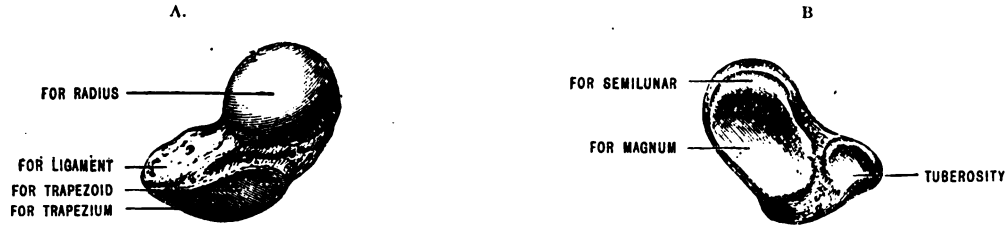


FIG. 101.—LEFT SCAPHOID: A, FROM OUTER SIDE AND BEHIND; B, INNER SIDE AND IN FRONT. (Morris.)

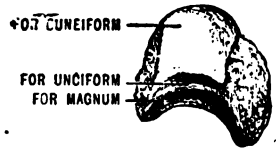


FIG. 102.—LEFT SEMILUNAR, FROM INNER SIDE AND BELOW. (Morris.)

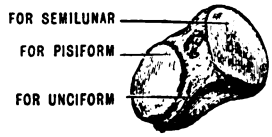


FIG. 103.—LEFT CUNEIFORM, FROM OUTER SIDE AND IN FRONT. (Morris.)

FIG. 104.—LEFT PISIFORM, FROM OUTER SIDE AND BEHIND. (Morris.)

FIGS. 105 & 106.—THE BONES OF THE LEFT WRIST FROM BEHIND; IN POSITION, AND SEPARATED. (Sappey.)

FIG. 107.—LEFT OS MAGANUM: A, FROM INNER SIDE; B, FROM OUTER SIDE. (Morris.)

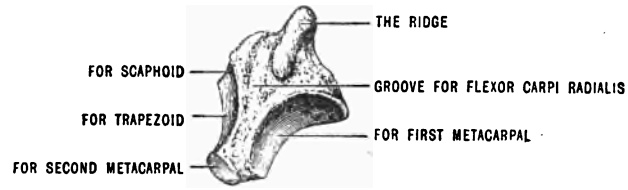


FIG. 108.—LEFT TRAPEZIUM, FROM IN FRONT. (Morris.)

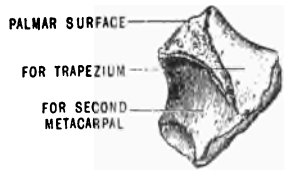


FIG. 109.—LEFT TRAPEZOID, FROM BELOW AND IN FRONT. (Morris.)

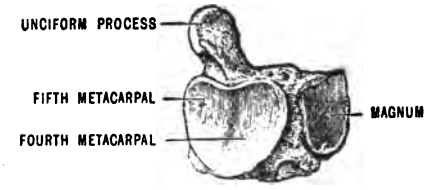


FIG. 110.—LEFT UNCIFORM, FROM BELOW AND IN FRONT. (Morris.)

FIGS. 111 AND 112.—THE BONES OF THE LEFT WRIST FROM BEHIND; IN POSITION, AND SEPARATED. (Sappey.)

BONES of the CARPUS — Second Row.

TRAPEZIUM — Presents:

ANT. INNER OR PALMAR SURFACE – Has a vertical groove for tendon of flexor carpi radialis, which groove is bounded externally by an oblique ridge for attachment of anterior annular ligament of carpus & abductor pollicis.

POST. OUTER OR DORSAL SURFACE – Large & rough.

UPPER SURFACE – Small, concave; articulates with scaphoid.

UNDER SURFACE – Convex from side to side and concave from before backwards (the bone being placed in its normal position, that is to say with its palmar surface looking almost directly inwards and nearly facing the unciform process of the unciform bone); articulates with the metacarpal bone of the thumb.

OUTER SURFACE – Broad & rough.

INNER SURFACE – Has a large superior concave articular surface for trapezoid, and a small narrow inferior facet for 2nd metacarpal bone.

TRAPEZOID — Presents:

ANT. & POST. SURFACES – Rough, the latter of which is the largest and is prolonged downwards & inwards.

UPPER SURFACE – Quadrilateral, concave, for scaphoid.

UNDER SURFACE – Saddle shaped for articulation with base of 2nd metacarpal bone.

OUTER SURFACE – Convex, smooth; articulates with trapezium.

INNER SURFACE – Concave & smooth below and in front for articulation with lower part of os magnum; rough above and behind for an interosseous ligament.

OS MAGNUM — May be divided into head, neck, & body. Presents:

ANT. & POST. SURFACES – Rough, the latter of which is the largest, and is prolonged downwards & inwards.

UPPER SURFACE – Rounded & smooth for semilunar.

UNDER SURFACE – Projects inwards in its posterior part, and has three facets (the middle one of which is the largest), for articulation with 2nd, 3rd & 4th metacarpal bones.

OUTER SURFACE – Presents from above downwards: a smooth convex surface for scaphoid, a rough groove which forms part of the neck, a small facet for trapezoid at anterior inferior angle, behind which latter is a depression for an interosseous ligament.

INNER SURFACE – Smooth behind for unciform bone, rough in front for an interosseous ligament.

UNCIFORM BONE — Presents:

ANT. OR PALMAR SURFACE – Presents the unciform process at its lower & inner part. This process projects directly forwards when the bone is placed in its normal position, and presents outer concave & inner convex surfaces, and an apex, which latter gives attachment to the anterior annular ligament of the carpus and to the flexor brevis & adductor or opponens minimi digiti.

POST. OR DORSAL SURFACE – Rough & triangular.

UPPER SURFACE OR ANGLE – Narrow, smooth, articulates with semilunar.

UNDER SURFACE – Has two facets for 4th & 5th metacarpal bones.

OUTER SURFACE – Smooth above & behind for os magnum, rough below and in front for an interosseous ligament.

INNER SURFACE – Smooth, convex above, concave below, articulates with cuneiform.

How to Class Scattered Bones of the Carpus into Right & Left.

It is easy to recognise whether a bone of the carpus belongs to the right or to the left side when it is placed in position as follows:

Scaphoid – Largest articular facet above;
Rough transverse groove behind;
Tubercle on outer side.

Semilunar – Convex articular facet above;
Largest rough surface in front;
Semilunar articular facet on outer side.

Cuneiform – Convex surface partly articular & partly non-articular, above;
Flat surface partly articular partly non-articular in front;
Small surface or angle on inner side.

Pisiform – Articular facet behind;
Non-articular part of same surface below,
Concave surface on inner side.

Trapezium – Saddle-shaped articular facet below;
Ridge in front;
Rough lateral surface on outer side.

Trapezoid – Saddle-shaped articular facet below;
Large rough surface behind;
Its projecting part on inner side.

Os Magnum – Head above;
Large rough surface behind;
Projecting part of the same (or tubercle of the base) on inner side.

Os Unciform – Unciform process below & in front;
Its concavity to outer side.

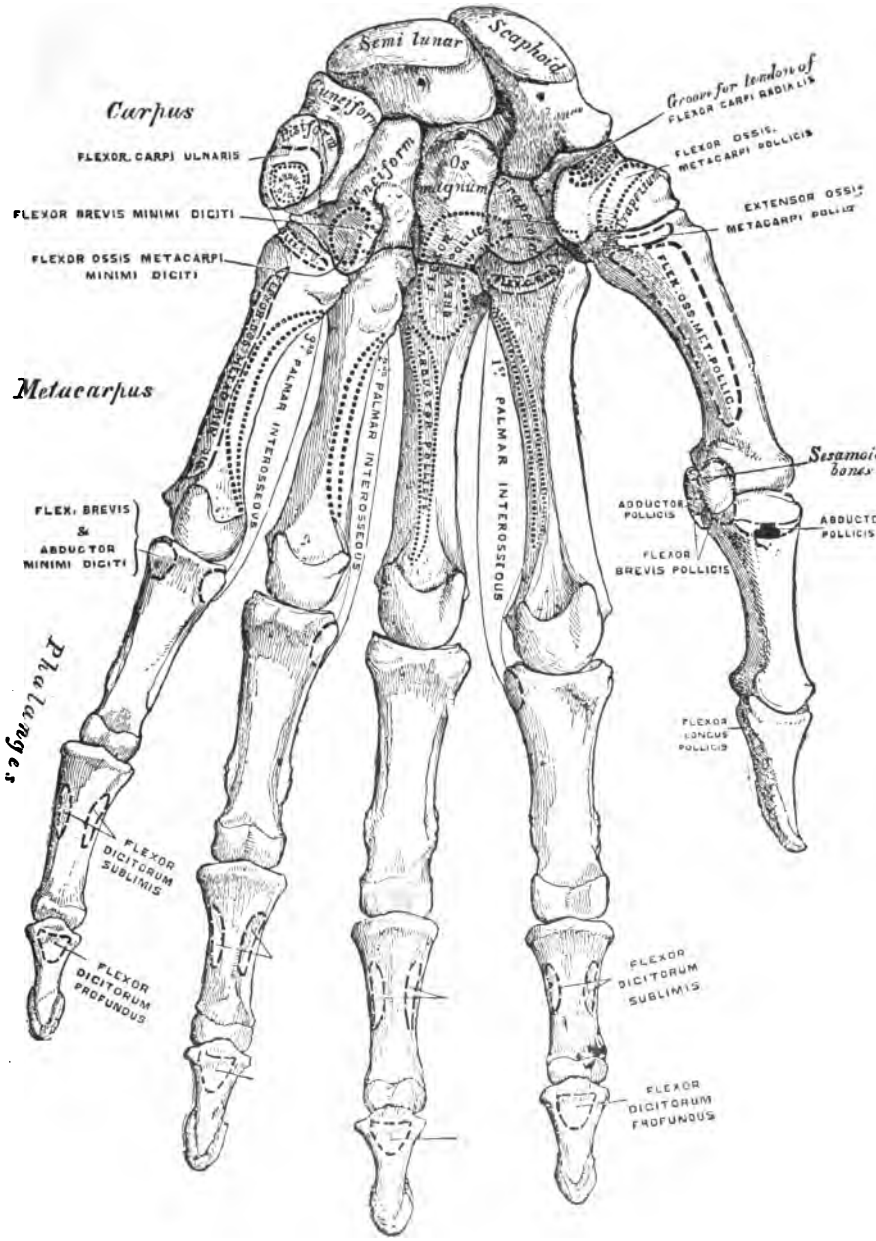


FIG. 113.—BONES OF THE LEFT HAND. PALMAR ASPECT. (Gray.

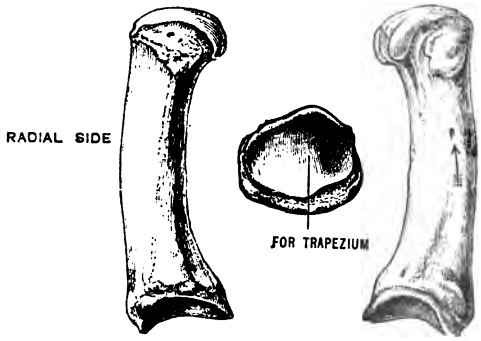


FIG. 114.—THE FIRST LEFT METACARPAL BONE. (Morris.)

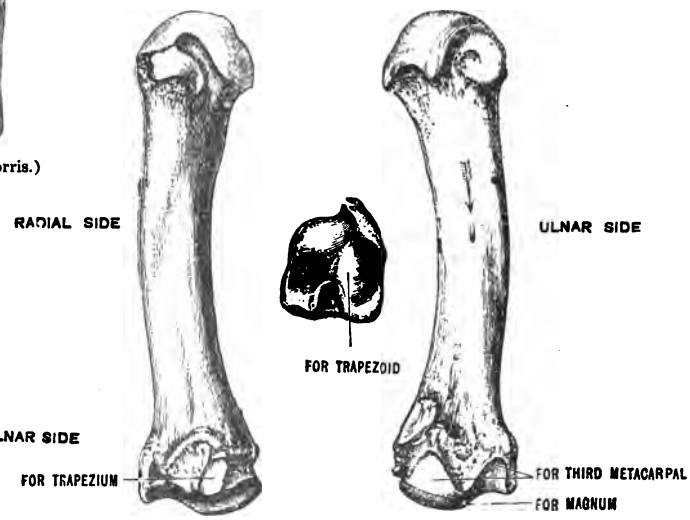


FIG. 115.—THE SECOND LEFT METACARPAL BONE. (Morris.)

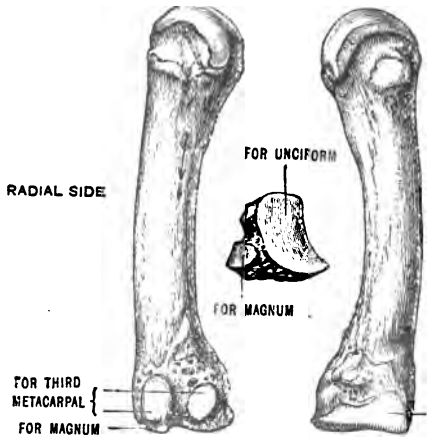


FIG. 117.—THE FOURTH LEFT METACARPAL BONE. (Morris.)

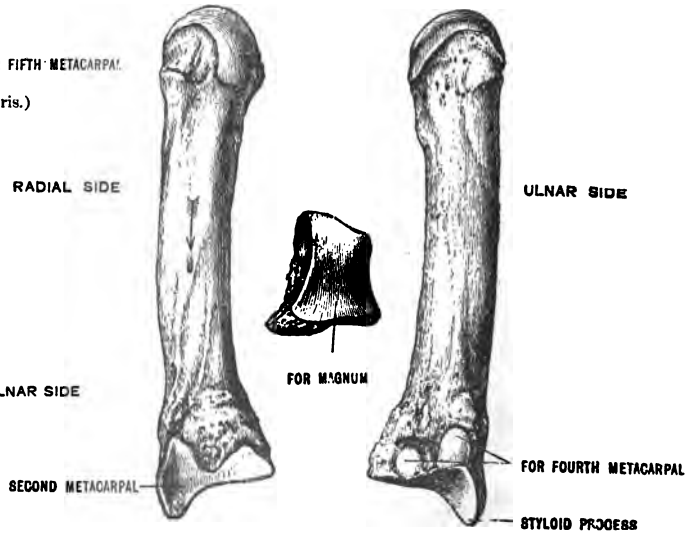


FIG. 116.—THE THIRD LEFT METACARPAL BONE. (Morris.)

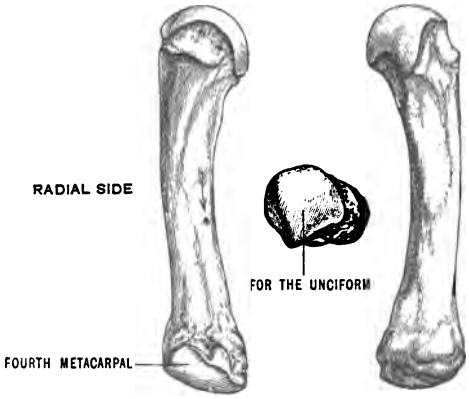


FIG. 118.—THE FIFTH LEFT METACARPAL BONE. (Morris.)

THE METACARPAL BONES

Long bones with shaft & two extremities.

COMMON CHARACTERS:

Shaft – Prismoid & concave anteriorly. Presents:
DORSAL SURFACE – Triangular, broad below, covered by extensor tendons.
LATERAL SURFACES – Concave, divided by a ridge into two parts for palmar & dorsal interossei. The ridge bifurcates below, and its branches end in the tubercles on either side of head.

Carpal Extremity or Base – Cuboid. Presents:
PALMAR & DORSAL SURFACES – Rough for ligaments; the latter is the largest.
SUP. & LATERAL SURFACES – Articular, for carpus & adjoining metacarpal bones.

Digital Extremity or Head – Presents:
INF. OR ARTICULAR SURFACE – Rounded, extending farther in front than behind, and slightly flattened from side to side.
LATERAL SURFACES – Depressed; present two tubercles, of which posterior one is for lateral ligt. of corresponding metacarpo-phalangeal articulation.
ANT. SURFACE – Grooved for flexor tendons.
POST. SURFACE – Broad & flat.

PARTICULAR CHARACTERS:

METACARPAL B. OF THUMB — The shortest.
SHAFT – Thick & broad; its palmar surface looks inwards.
CARPAL EXTREMITY – Saddle-shaped for trapezium (convex from before backwards, concave from side to side) & broadest externally; no lateral facets.
DIGITAL EXTREMITY – Broader & less convex anteriorly than in the other metacarpal bones; presents two small lateral facets for sesamoid bones.

METACARPAL B. OF INDEX — The longest.
CARPAL EXTREMITY – Larger than in the others, and presents posteriorly a prolongation upwards & inwards towards os magnum. Has four articular surfaces, one saddle-shaped above for trapezoid, and three others for trapezium, os magnum & 3rd metacarpal bone.

METACARPAL B. OF MIDDLE FINGER — The longest but one.
CARPAL EXTREMITY – Presents a prolongation upwards & outwards behind os magnum, and has four articular facets, one for os magnum, one for 2nd metacarpal bone, and two for 4th.

METACARPAL B. OF RING FINGER — Short.
CARPAL EXTREMITY – Pretty regularly cuboid. Presents five facets for unciform, os magnum, 3rd (two facets), & 5th metacarpal bones.

METACARPAL B. OF LITTLE FINGER — The smallest & the shortest but one.
CARPAL EXTREMITY – Has a prominent tubercle on inner side for extensor carpi ulnaris; carpal facet is saddle-shaped for unciform; only one lateral facet for 4th metacarpal bone.

N.B.—The foregoing characters supply the three points requisite to place the bones in position, and therefore to distinguish between right bones and left bones.

THE PHALANGES

Fourteen, three to each finger, two to thumb. Are long bones and present:

Shaft – Slightly curved anteriorly. Flat from side to side on palmar surface, convex on dorsal. Margins prominent for attachment of sheaths of flexor tendons. – The shaft is longer in first or proximal phalanges than in second, in second than in third.

Proximal Extremity – The largest. Presents:
IN FIRST ROW – Oval, concave, articular surface, broadest from side to side.
IN SECOND & THIRD ROWS – Two lateral concavities & a median ridge.

Distal Extremity – The smallest. Presents:
IN FIRST & SECOND ROWS – A trochlear surface prolonged farther in front than behind.
IN THIRD ROW – A rough horse-shoe shaped eminence on palmar surface.

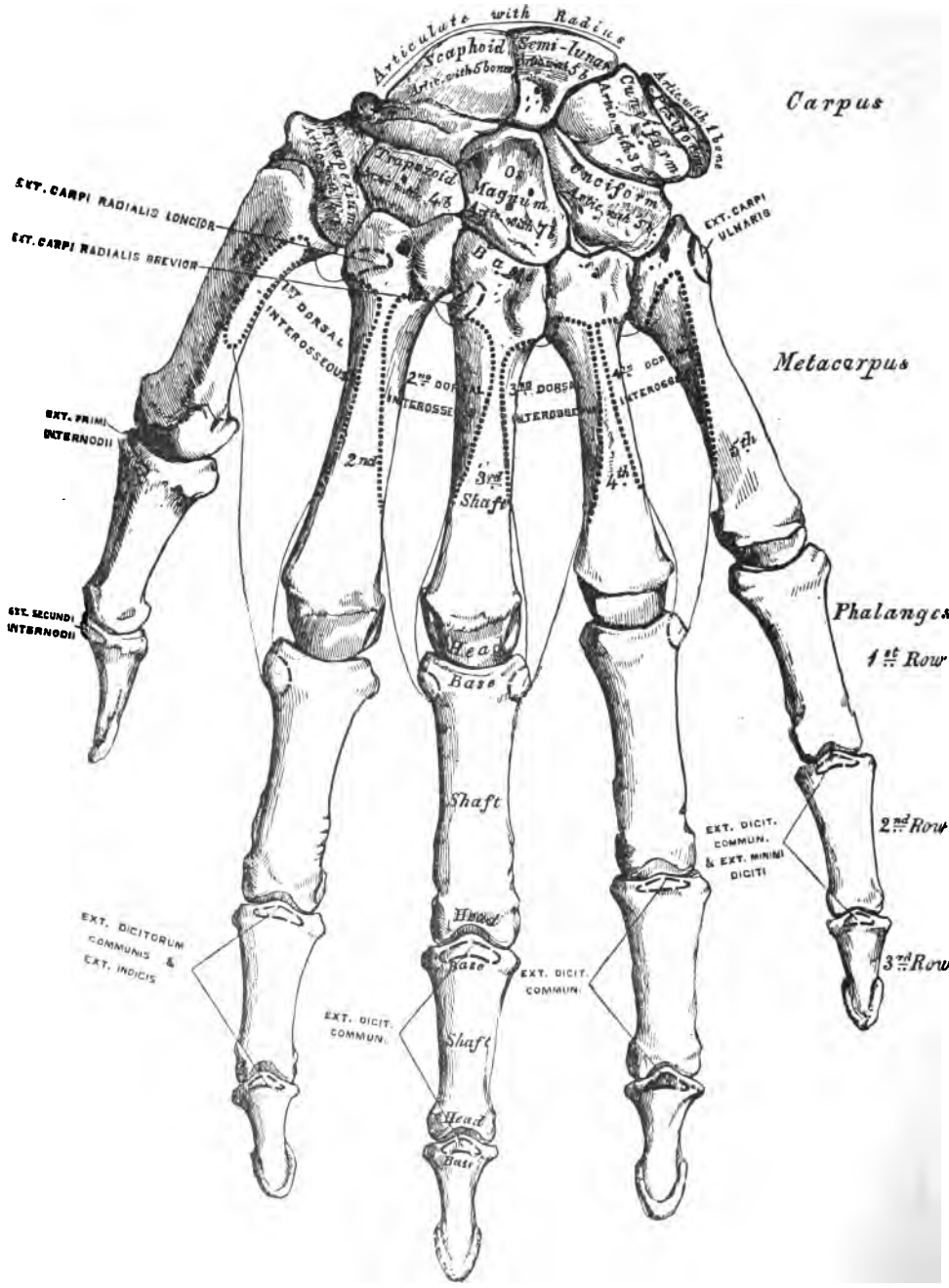


FIG. 119.—BONES OF THE LEFT HAND. DORSAL ASPECT. (Gray.)

BONES OF THE LOWER LIMB.

THE INNOMINATE BONE — 1st Tablet.

Large irregular flat bone, constricted towards its middle, and expanded above & below; so twisted upon itself that its superior expansion is directed inwards posteriorly & outwards anteriorly, while its inferior expansion is curved inwards in front as far as the middle line.

Consists up to the 13th or 14th year of three distinct portions, the ilium, ischium & pubes, which portions, though they subsequently unite, are usually described separately

ILIUM — The superior expanded portion. Presents:

Outer Surface, or Dorsum – Convex in front, where it looks downwards & outwards, concave behind, where it looks downwards, outwards & backwards. Presents the

Three Curved Lines, superior, middle, & inferior, which commence respectively two inches in front of the posterior extremity of the crest, an inch & a half behind its anterior extremity, & at the upper part of the anterior inferior spinous process, and which converge, the two first towards the upper part, & the third towards the middle of the great sacro-sciatic notch

Above, and between these lines are seen the

Surfaces of origin of the glutei maximus, medius & minimus;

Groove (sometimes a ridge), for reflected tendon of rectus. – Below this are the

Upper part of rim of acetabulum;

Triangular segment of the acetabulum forming nearly 2-5ths of that cavity, which 2-5ths include the greater part of the articular surface.

Inner Surface – Presents in front, behind, & below respectively:

INTERNAL ILIAC FOSSA OR VENTER – Bounded below by the ilio-pectineal line, and presenting inferiorly a nutrient foramen.

SACRO-ILIAC ARTICULAR SURFACE – Which is divided into an

Inferior or Auricular Portion – Covered with cartilage, smooth though uneven, and a

Superior Rough Portion – For posterior sacro-iliac ligaments.

PORTION OF INNER SURFACE OF TRUE PELVIS – Corresponding to upper part of acetabulum.

Upper Border or Crest – Convex from before backwards, curved like an italic *f*, concave externally behind, where it is thickest, convex externally in front, where it is also very thick, divided into:

Outer lip for latissimus dorsi, obliquus externus, tensor vaginæ femoris & fascia lata.

Inner lip for erector spinæ, quadratus lumborum & transversalis;

Interspace for internal oblique.

Anterior Border – Long, concave, nearly vertical; presents from above downwards:

Anterior superior spine for Poupart's ligament, sartorius, tensor vaginæ femoris & iliacus:

Notch for lower fibres of sartorius, and exit of external cutaneous nerve;

Anterior inferior spine for straight tendon of rectus;

Broad shallow groove for exit of psoas & iliacus.

Posterior Border — Shorter, more horizontal. Presents:

Posterior superior spine for erector spinæ & oblique sacro-iliac ligament;

Slight notch;

Posterior inferior spine for part of great sacro-siatic ligament;

Upper part of great sacro-sciatic notch.

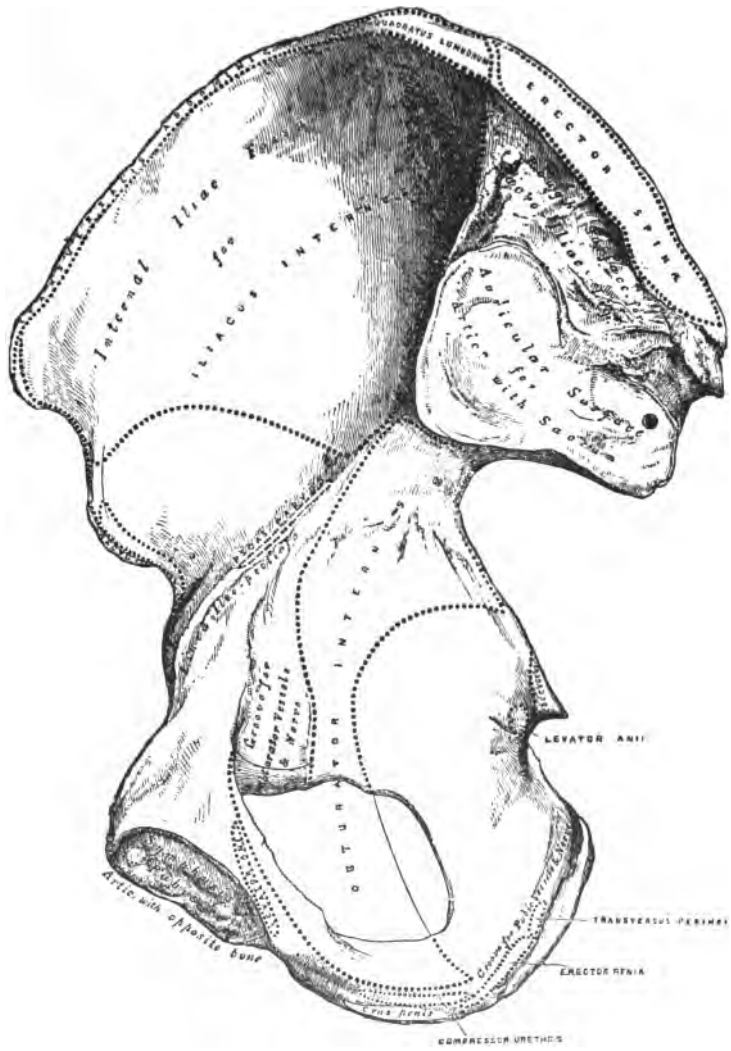


FIG. 120.—RIGHT INNOMINATE BONE. INNER SURFACE. (Gray.)

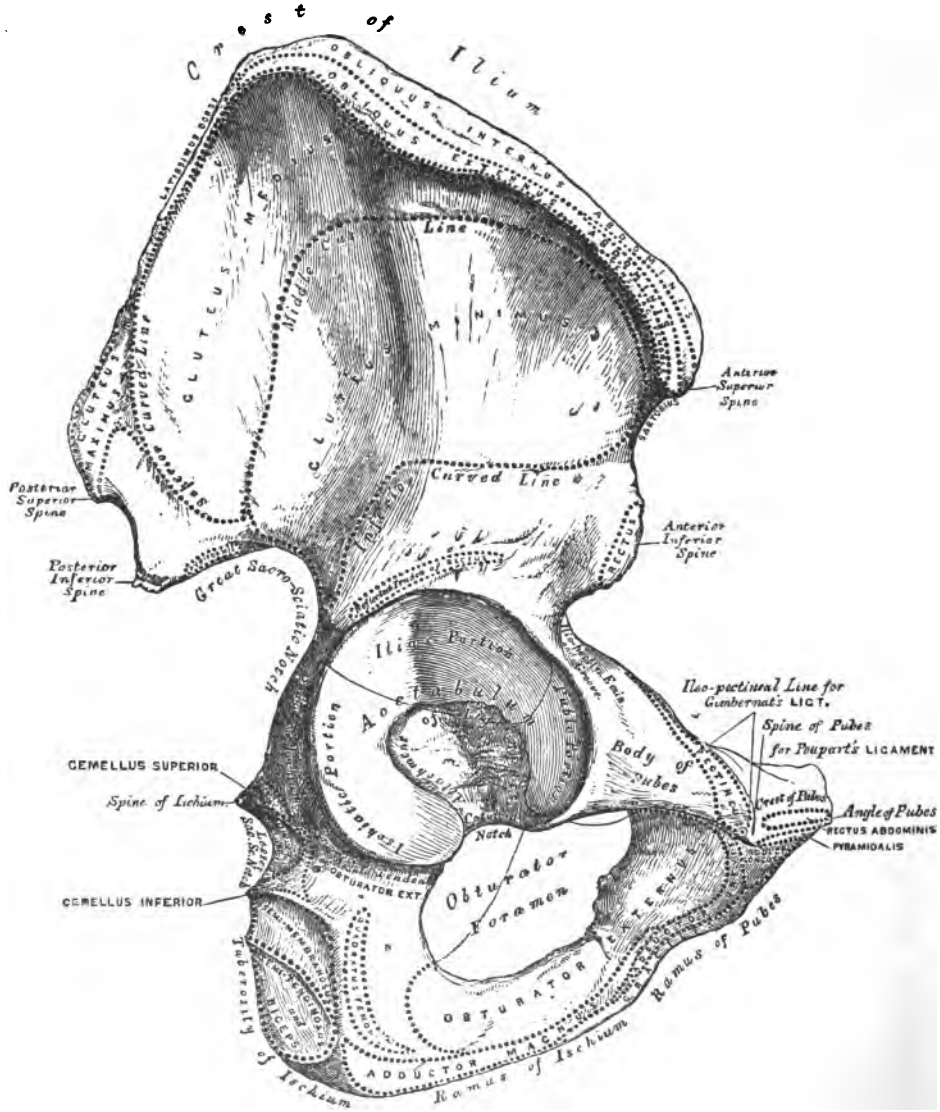


FIG. 121.—RIGHT INNOMINATE BONE. OUTER SURFACE. (Gray.)

THE INNOMINATE BONE — 2nd Tablet.

ISCHIUM — The lower, posterior & thick part. Bounds obturator foramen below & behind, and presents body, tuberosity & ascending ramus.

Body – Presents three surfaces & three borders:

OUTER SURFACE – Presents from above downwards:
A little more than 2-5ths of the acetabulum comprising the greater part of the central non-articular depression;
Lower part of rim of acetabulum with a portion of the cotyloid notch;
Deep groove for passage of tendon of obturator externus;
Posterior part of circumference of obturator foramen for obturator externus & adductor magnus.

INNER SURFACE – Forms lower part of lateral boundary of true pelvis & posterior part of circumference of obturator foramen. It gives origin to obturator internus, presents two or three large vascular foramina, and is grooved inferiorly for passage of pudic vessels & nerve.

POSTERIOR SURFACE – Quadrilateral, smooth, broadest above, supports the pyriformis, obturator internus, & gemelli.

ANTERIOR BORDER – Thin; for obturator membrane.

OUTER BORDER – Thick & short.

INNER BORDER – The longest. Presents from above downwards:
Lower part of great sacro-sciatic notch. – This notch is converted by lesser sacro-sciatic ligament into great sacro-sciatic foramen, which foramen transmits from above downwards:
Gluteal vessels & superior gluteal nerve;
Pyriformis muscle;
Sciatic artery, greater & lesser sciatic nerves, pudic vessels & nerve, & nerve to obturator internus;
Spine of ischium – For lesser sacro-sciatic ligament, gemellus superior, coccygeus, & posterior fibres of levator ani.
Lesser sacro-sciatic notch – Coated with fibro-cartilage, and converted by both sacro-sciatic ligaments into lesser sacro-sciatic foramen for obturator internus muscle, its nerve, and pudic vessels & nerve.

Tuberosity – Corresponds to lower and back part of body, and may be described as presenting:

OUTER LIP – For gemellus inferior, quadratus femoris, & adductor magnus.

INNER LIP – For transversus perinæi, crus penis or clitoridis, erector penis or clitoridis, & anterior or falciform prolongation of great sacro-sciatic ligament.

INTERSPACE – Presents four rough surfaces:
Two Anterior or Inferior separated by a prominent ridge,
the external, for the adductor magnus;
the internal for the great sacro-sciatic ligament.
Two Posterior or Superior separated by a rough line oblique downwards & outwards,
the external (the most superior of the two), for semimembranosus;
the internal (the most inferior of the two) for common tendon of semitendinosus & long head of biceps.

Ascending Ramus – Thin & flattened; passes upwards & inwards, bounding obturator foramen inferiorly, and joins with descending ramus of pubes. Presents:

OUTER SURFACE – Rough, for gracilis, obturator externus & adductor magnus.

INNER SURFACE – Smoother, for obturator internus.

UPPER BORDER – Thin & sharp, for obturator membrane.

LOWER BORDER – Rough, thick; everted, especially in the female; for gracilis, crus penis or clitoridis, erector penis or clitoridis, transversus perinæi, deep perineal fascia deep layer of the superficial fascia.

THE INNOMINATE BONE -- 3rd Tablet.

PUBES — The anterior & inner part. Bounds obturator foramen above & in front, and presents body, horizontal ramus & descending ramus.

Body — Quadrilateral, flattened from before backwards & outwards, and presents:

ANTERIOR SURFACE – Rough, slightly excavated, giving origin to the adductor longus immediately below the crest, and, lower down, to obturator externus, adductors brevis & magnus, & upper part of gracilis.

POSTERIOR SURFACE – Smooth, convex from above downwards, concave from side to side, giving attachment to obturator internus, levator ani, and pubo-prostatic ligaments or anterior true ligaments of bladder.

UPPER BORDER – Presents from within outwards the

Angle – In front of which the inner pillars of external abdominal ring decussate with each other (as they do also in front of symphysis);

Crest – To which are attached, anteriorly the conjoined tendon of the internal oblique & transversalis, and posteriorly the rectus & pyramidalis;

Spine – For Poupart's ligament & outer pillar of external abdominal ring;

Commencement of ilio-pectineal line, for conjoined tendon, Gimbernat's ligament & the triangular ligament.

INNER BORDER – Presents a rough oval facet, which forms part of symphysis.

OUTER BORDER – Thin, for obturator membrane.

Horizontal Ramus – Is far from being horizontal, since it forms part of the brim of the true pelvis, which brim is inclined at an angle of about 60° with the horizontal. Presents:

UPPER SURFACE – Presents from within outwards:

Triangular surface for origin of pectineus, behind which surface is the *Continuation of the ilio-pectineal line* already mentioned;

Ilio-pectineal eminence, which supports brim of acetabulum, and gives attachment to psoas parvus when that muscle exists.

UNDER SURFACE – Presents a

Groove oblique forwards & inwards for obturator vessels & nerve, which groove is bounded internally by a

Sharp margin forming part of circumference of obturator foramen.

POSTERIOR SURFACE – For upper fibres of obturator internus; forms part of anterior boundary of true pelvis.

OUTER EXTREMITY – Forms about 1-5th of the acetabulum.

Descending Ramus – Thin & flattened; passes downwards & outwards, and joins with ascending ramus of ischium. Presents:

ANTERIOR SURFACE – Rough, for adductors brevis & magnus, obturator externus & gracilis.

POSTERIOR SURFACE – Smoother, for obturator internus.

INNER BORDER – Rough, thick; everted, especially in the female; for gracilis, crus penis or clitoridis, erector penis or clitoridis, compressor urethræ, deep perinæal fascia, & deep layer of the superficial fascia.

OUTER BORDER – Thin & sharp, for obturator membrane.

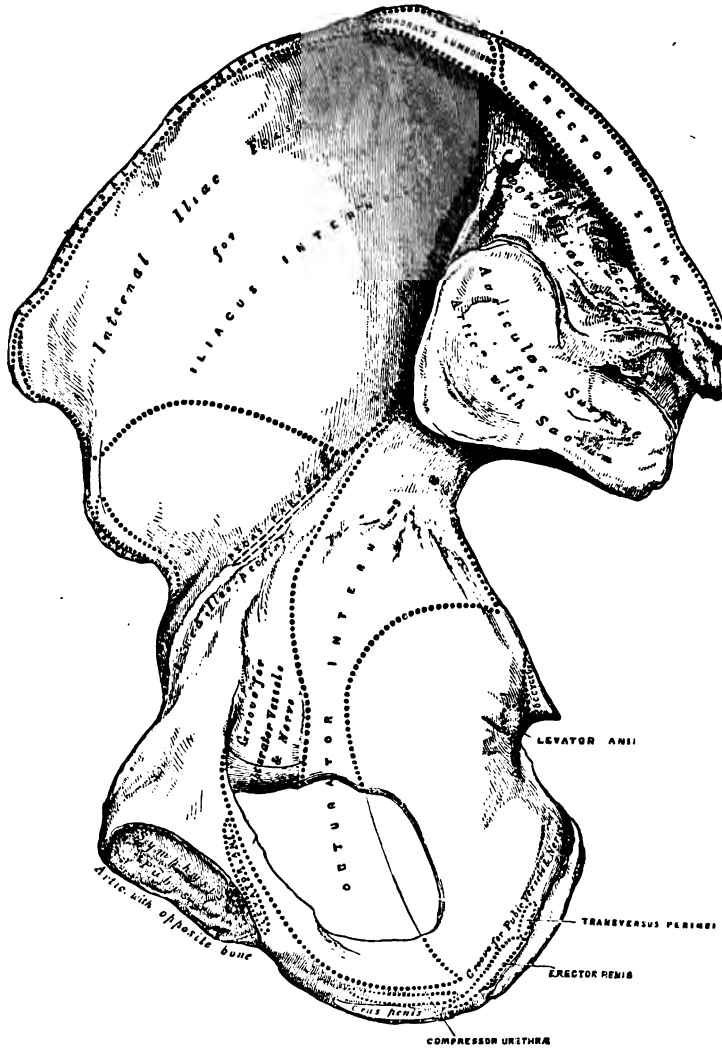


FIG. 122.—RIGHT INNOMINATE BONE: INNER SURFACE. (Gray.)

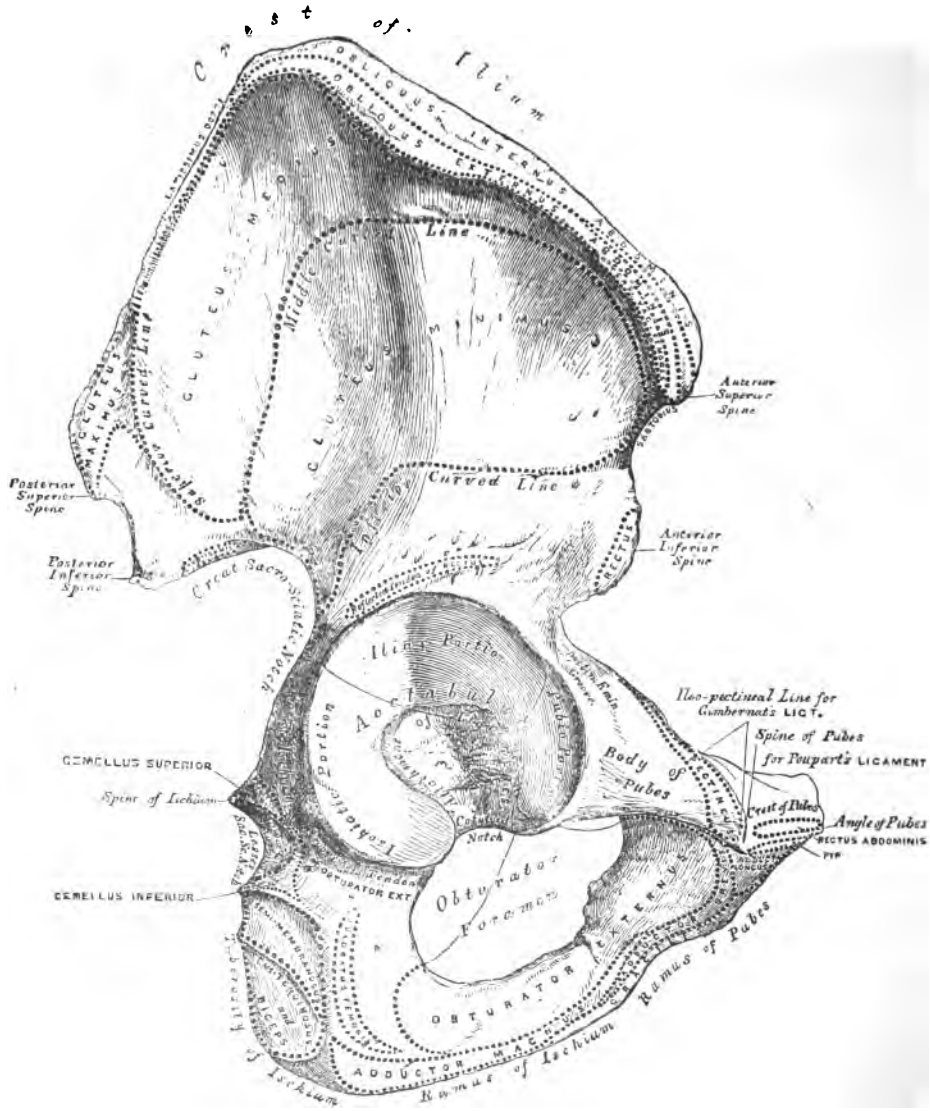


FIG. 123.— RIGHT INNOMINATE BONE : OUTER SURFACE. (Gray.)

THE INNOMINATE BONE — 4th Tablet

ACETABULUM, or COTYLOID CAVITY — Deep, hemispherical, formed by all the three parts which make up the innominate bone: – the ilium forming a little less than 2-5ths, including the largest part of the articular ring; the ischium forming a little more than 2-5ths, including the greater part of the central non-articular depression; the pubes forming the remaining 1-5th.

Looks downwards, forwards, & outwards.

Is surrounded, except below & in front, by an elevated margin for attachment of the cotyloid ligament. This margin is most prominent behind, is slightly depressed between the pubes & the ilium, and is deficient between the pubes & the ischium, in which latter situation the resulting

Cotyloid notch – Leads into the central non-articular depression; the margins of this notch give attachment to the round & transverse ligaments.

Is divided into an

Incomplete Articular Ring – Broadest in its iliac portion, which portion is the most extensive of the three, & deficient opposite the cotyloid notch; and a

Central Non-Articular Depression – Rough, nearly circular, continuous with the cotyloid notch, and formed chiefly by the ischium; this depression lodges a mass of fat which forms a bed for the round ligament.

OBTURATOR or THYROID FORAMEN, or FORAMEN OVALE— Comprised between the pubes & ischium; large & oval in male; smaller, triangular, narrow inferiorly in female. Closed by obturator membrane, except in its upper part, where the upper border of the membrane converts the groove on under surface of horizontal ramus into a complete foramen for obturator vessels & nerve.

THE FEMUR

The largest, longest, & strongest bone of the skeleton; slightly oblique downwards & inwards, especially in female. Presents:

UPPER EXTREMITY — Presents:

Head – Forms nearly two-thirds of a sphere, and looks upwards forwards & inwards. Presents a little below & behind its centre a small circular *Depression* for ligamentum teres.

Neck – Flattened from before backwards, expanded inferiorly, thicker above than below, bounded by the intertrochanteric lines. Longest & most inclined in youth; shorter and more horizontal as age advances, especially in female. Presents:

ANT. SURFACE – Continuous with anterior surface of shaft, perforated by numerous vascular foramina.
POSTERIOR SURFACE – Concave, rather broader; gives attachment externally to posterior part of capsule of hip-joint.
UPPER BORDER – Short, thick, horizontal.
LOWER BORDER – Longer, thinner, oblique downwards & backwards to lesser trochanter.

Greater Trochanter – Large, quadrilateral, most prominent posteriorly. Presents:

OUTER SURFACE – Presents
Oblique line extending downwards & forwards, for gluteus medius; – the surface is smooth below & behind this line for a bursa, and sometimes rough above & in front for some of the fibres of gluteus medius.
INNER SURFACE – Presents the
Digital or trochanteric fossa for obturator externus.
UPPER BORDER – For obturator internus & gemelli in front, & pyriformis behind.
LOWER BORDER – Marked externally by a rough
Horizontal ridge for vastus externus.
ANTERIOR BORDER – Rough above & externally for gluteus minimus, below & internally for vastus externus. On its inner side towards its middle is a rough prominence, the *Tubercle of the femur*, which marks point of meeting of gluteus minimus, vastus externus and obturator internus & gemelli (Gray), and is continued inferiorly into the *Anterior intertrochanteric line*, less prominent than the posterior, oblique downwards & inwards, rough for front part of capsule; joins inferiorly with superior internal prolongation of linea aspera.
POSTERIOR BORDER – Longer, more prominent; continued inferiorly into the
Posterior intertrochanteric line prominent, oblique downwards & inwards to lesser trochanter; presents towards its middle the upper extremity of the
Linea quadrati for quadratus femoris.

Not such a Linea as Linea quadrati (Gray)

Lesser Trochanter – Smaller, conical, for psoas; lies at lower inner & back part of neck, at point of meeting of posterior intertrochanteric line, lower border of neck, and superior median prolongation of linea aspera.

LOWER EXTREMITY — Expanded, broad from side to side. Presents posteriorly the deep

Intercondyloid Notch – Which separates posteriorly the condyles, which latter are joined in front by patellar portion of their articular surface.

Inner Condyle – The longest, narrowest, most curved, and most prominent inferiorly when the bone is held vertically; presents:

Inner tuberosity, more prominent than the external; gives attachment to internal lateral ligament of knee-joint.
Tubercle, for tendon of adductor magnus, at upper & back part;
Depression for inner head of gastrocnemius, above & behind articular surface;
Outer rough surface forming part of intercondyloid notch, & giving attachment anteriorly to posterior crucial ligament.

Outer Condyle – The shortest, broadest, least curved, & most prominent anteriorly; presents:

Outer tuberosity, less prominent than the internal; gives attachment to external lateral ligament of knee-joint;
1st & oblique groove for popliteus, below & externally;
Depression for outer head of gastrocnemius, above & behind articular surface;
Inner rough surface forming part of intercondyloid notch, and giving attachment posteriorly to anterior crucial ligament.

ARTICULAR SURFACE — Is divided anteriorly into a patellar & two tibial portions by two slightly depressed posteriorly converging lines, of which the one that bounds the patellar portion internally is continued backwards along outer & front part of inner condyle, so as to cut off an additional narrow tract from inner side of intercondyloid notch.
PATELLAR PORTION – Occupies front of condyles, is trochlear in shape, broadest, highest & most prominent externally, and presents a slight prolongation backwards along inner side of intercondyloid notch; it is this prolongation that articulates during flexion of knee-joint with the small facet on posterior aspect of inner border of patella (Lenoir, Goodsir).
TIBIAL PORTION – Covers the slightly flattened under surfaces & the posterior rounded surfaces of the condyles.

SHAFT — Nearly cylindrical, convex forwards & outwards, enlarged & flattened from before backwards below. Presents:

Surfaces – Three; all broadest below:

ANTERIOR – For subcrureus & inner part of crureus; covered below by upper part of capsule of knee-joint.
EXTERNAL – For outer part of crureus; covered by vastus externus
INTERNAL – For vastus internus.

Borders – Three:

POSTERIOR, OR LINEA ASPERA – Very prominent; for vasti, adductors longus, brevis, magnus, & short head of biceps; trifid above, bifid below, presenting therefore five prolongations:
Superior External – To great trochanter, for vastus externus, gluteus maximus & upper part of adductor magnus;
Superior Internal – To inner side of neck, where it joins with anterior intertrochanteric line, for upper part of vastus internus;
Superior Median – To lesser trochanter, for iliacus, pectineus & upper part of adductor brevis;
Inferior External – To upper & back part of outer condyle, for vastus externus, short head of biceps, plantaris, & outer head of gastrocnemius;
Inferior Internal – Faintly marked where it is crossed by femoral artery, to upper & back part of inner condyle, for vastus internus, adductor magnus & inner head of gastrocnemius. – These two latter prolongations embrace a triangular surface, which supports the popliteal vessels & nerves.
INTERNAL – From inner side of neck to front of inner condyle;
EXTERNAL – From front of great trochanter to front of outer condyloid, – both rounded & faintly marked

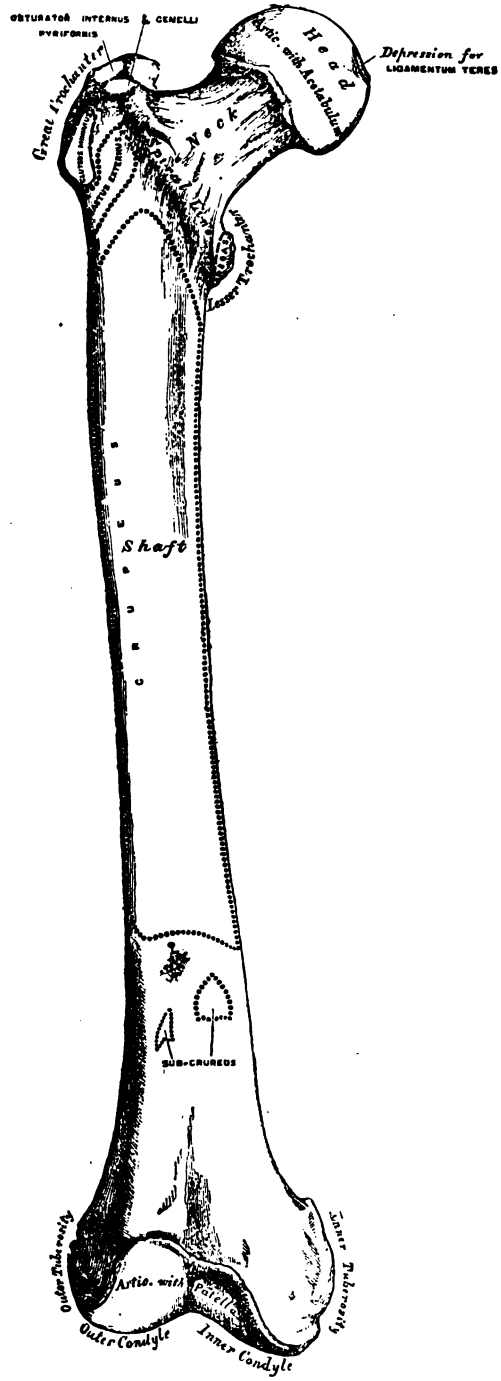


FIG. 124.—RIGHT FEMUR : ANTERIOR VIEW. (Gray.)

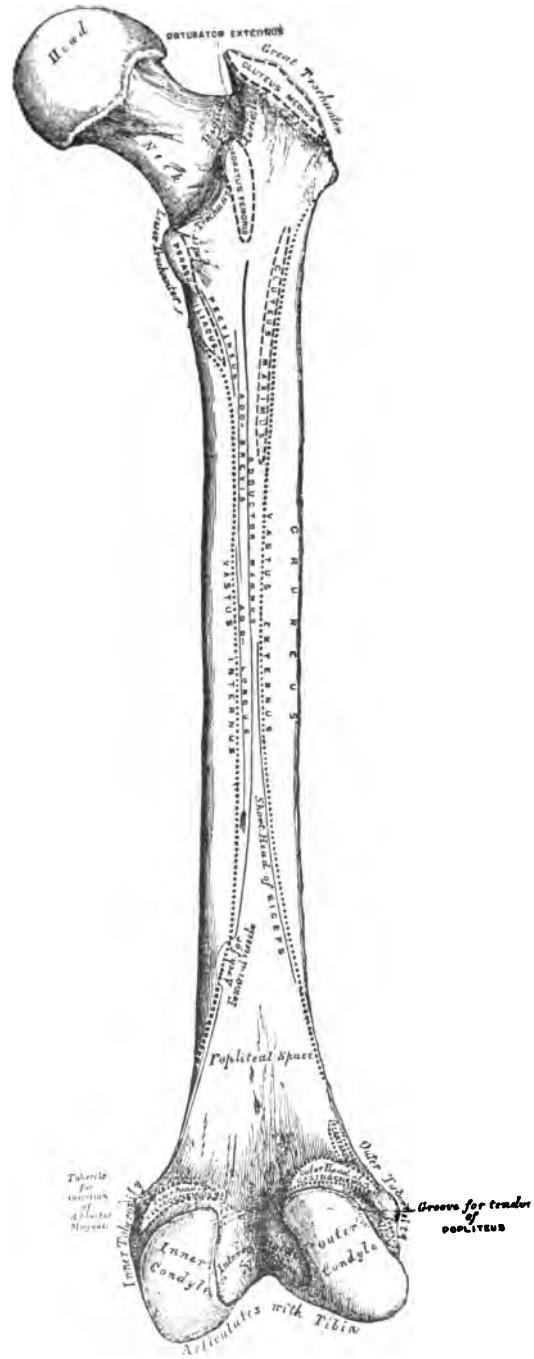


FIG. 125.—RIGHT FEMUR : POSTERIOR VIEW. (Gray.)

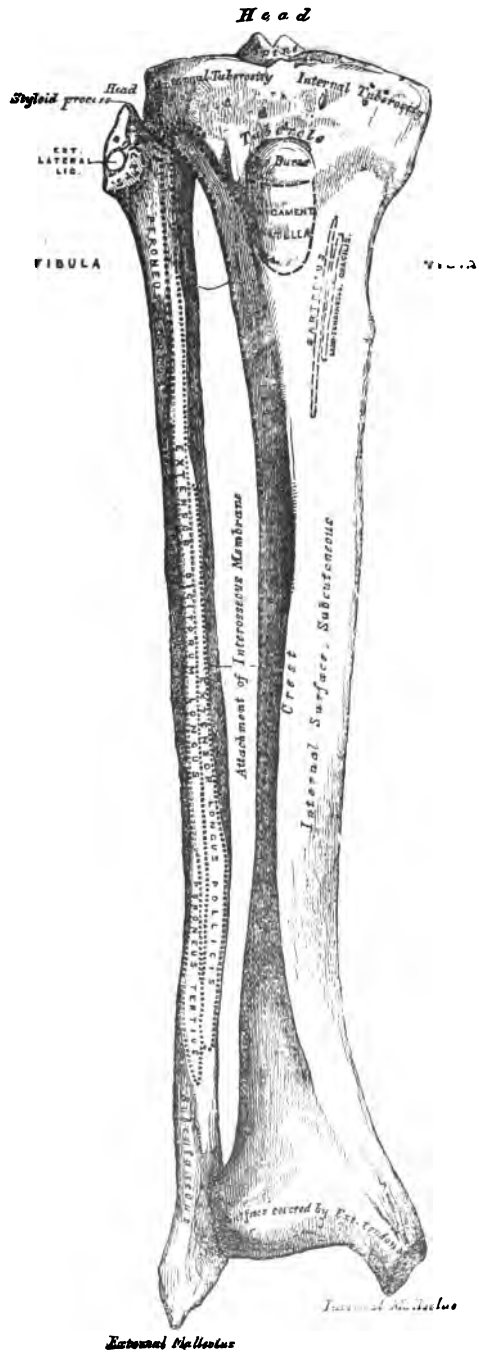


FIG. 126.—BONE OF THE RIGHT LEG. ANTERIOR VIEW. (Gray.)

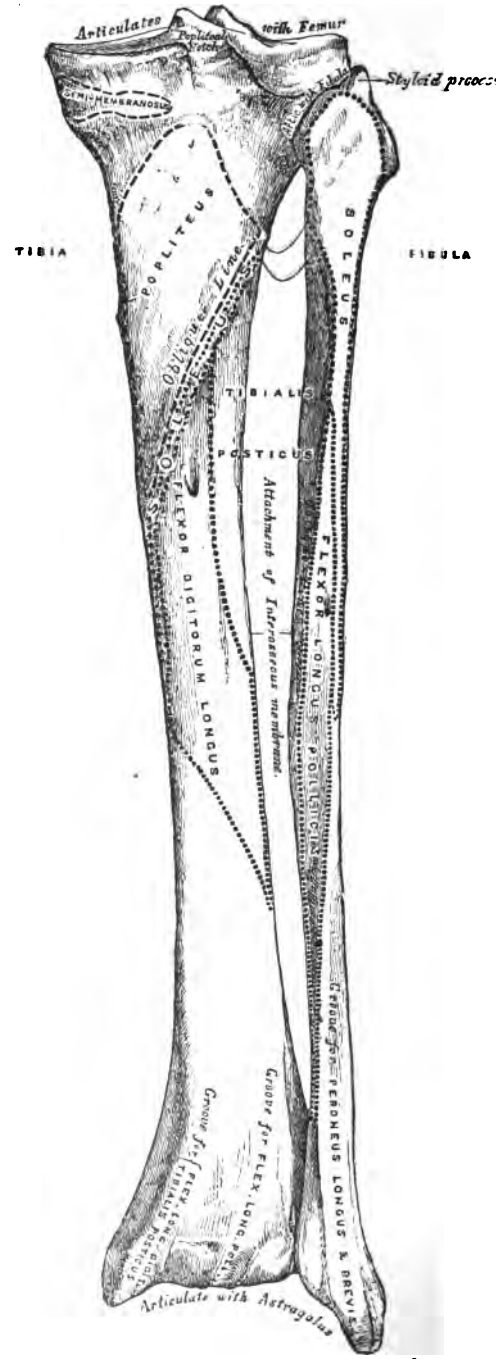


FIG. 127.—BONES OF THE RIGHT LEG. POSTERIOR VIEW. (Gray.)

THE TIBIA

Prismoid, expanded above, slightly enlarged below, twisted inwards inferiorly, oblique downwards & outwards in female. Presents:

UPPER EXTREMITY or HEAD — Broad from side to side, and formed by inner & outer tuberosities which tuberosities correspond to & support condyles of femur, and are separated by a slight notch both in front & behind. Presents:

Upper Surface - Presents the two condyloid surfaces, oval & slightly elongated from before backwards, and separated from each other by the spine and by two rough triangular depressions situated one in front of the spine & the other behind it.

INTERNAL CONDYLOID SURFACE - The longest, narrowest, & deepest.

EXTERNAL CONDYLOID SURFACE - The shortest, broadest, & shallowest.

SPINE - Surmounted by two prominent tubercles formed by the prolongation backwards & outwards, and forwards & inwards, respectively, of the internal & external condyloid surfaces.

ANTERIOR ROUGH DEPRESSION - The largest; gives attachment from before backwards to anterior extremity of internal semilunar fibro-cartilage, anterior crucial ligament, anterior extremity of external semilunar fibro-cartilage.

POSTERIOR ROUGH DEPRESSION - Rather smaller; gives attachment from before backwards to posterior extremities of external & internal semilunar fibro-cartilages & to posterior crucial ligament.

Outer Surface - Presents outer surface of outer tuberosity, which tuberosity is the most prominent of the two, and is marked posteriorly by a small circular

Facet looking downwards, outwards & backwards, for fibula.

Inner Surface - Presents inner surface of inner tuberosity, which tuberosity, the less prominent of the two, gives attachment to internal lateral ligt. of knee-joint, and is marked by a

Groove for insertion of one of the tendons of semimembranosus.

Anterior Surface - Presents a large rough triangular surface, perforated by numerous vascular foramina, broad above, ending inferiorly in the

Tubercle of the tibia rough inferiorly for ligamentum patellæ, smooth superiorly for a bursa.

Posterior Surface - Presents the posterior aspect of the tuberosities, which are separated by the

Popliteal notch for posterior crucial ligament & part of posterior ligament of knee-joint. The inner tuberosity gives attachment posteriorly to one of the tendons of semimembranosus & to principal fasciculus of foregoing ligament.

LOWER EXTREMITY — Smaller, quadrangular. Presents:

Inferior or Articular Surface - Quadrilateral, concave from before backwards, broadest in front, narrowest internally, where it is continuous with outer surface of internal malleolus, marked by a

Slight antero-posterior elevation separating two

Shallow lateral-depressions.

Anterior Surface - Broad, convex, smooth, covered by tendons of tibialis anticus, extensor proprius pollicis & extensor longus digitorum, and marked inferiorly by a

Slight groove for anterior ligament of ankle-joint.

Posterior Surface - Rather narrower; presents a

Broad shallow groove, oblique downwards & inwards for tendon of flexor longus pollicis.

Inner Surface - Prolonged downwards into the

INTERNAL MALLEOLUS - Shorter, but rather broader than the external, and presents: -

Inner Surface - Subcutaneous, convex;

Outer Surface - Articular; deepens internally the articular surface for astragalus.

Anterior Border - Rough, for anterior portion of deltoid ligament.

Posterior Border - Presents a

Broad & deep groove, oblique downwards & inwards, divided by a slight ridge into inner & outer portions for tendons of tibialis posticus & flexor longus digitorum

Apex - Rough & slightly grooved for middle portion of deltoid ligament.

Outer Surface - Bounded by branches of bifurcation of outer border; presents inferiorly a

Narrow concave facet for external malleolus, and superiorly a

Rough triangular depression for interosseous ligament of inferior tibio-fibular articulation

SHAFT — Triangular, expanded above & below, narrowest at junction of middle & lower thirds; presents:

Surfaces - Three:

INTERNAL - Smooth, convex, subcutaneous, except at upper part, where it gives attachment to tendons of sartorius, gracilis & semitendinosus.

EXTERNAL - Excavated in upper two-thirds for origin of tibialis anticus; rounded off & curved forwards anteriorly in lower third, where it is covered by tendons of tibialis anticus, extensor proprius pollicis & extensor longus digitorum.

POSTERIOR - Presents superiorly a large

Triangular surface for popliteus, which surface is bounded below by the

Oblique line for popliteus, soleus, tibialis posticus & flexor longus digitorum. **Below this line is the**

Nutrient foramen directed downwards, and a

Vertical ridge, which divides middle third of posterior surface into

Inner broader portion for flexor longus digitorum, and

Outer narrow portion for tibialis posticus; and then becomes lost inferiorly upon a

Smooth surface covered by tendons of tibialis posticus, flexor longus digitorum, & flexor proprius pollicis

Borders - Three:

ANTERIOR OR CREST - From tubercle of tibia to anterior border of internal malleolus; curved like an italic *S*, concave externally above, internally below; very prominent in upper two-thirds; for deep fascia of leg.

INTERNAL - From back of inner tuberosity to posterior border of internal malleolus; gives attachment to popliteus, soleus & flexor longus digitorum.

EXTERNAL, OR INTEROSSEOUS RIDGE - From front of fibular facet to apex of triangular rough surface on outer side of lower extremity, to embrace which it bifurcates inferiorly; thin & prominent, especially towards middle

THE FIBULA — 1st Tablet.

Very slender, and of about the same length as the tibia. Inclined downwards & forwards, convex posteriorly, convex internally below. Presents a shaft & two extremities.

SHAFT — Presents *four* borders & *four* surfaces. – (For classical description, see next Tablet).

Borders – Are:

ANTERO-EXTERNAL – Usually called ANTERIOR. Well marked & prominent. Commences at front of head. Descends along upper 3-4ths of the bone, slightly deviating outwards inferiorly, and bifurcates below to embrace the triangular subcutaneous surface above external malleolus. It gives attachment to the septum between the extensor muscles & the peronei.

ANTERO-INTERNAL, OR INTEROSSEOUS RIDGE – Lies close to the preceding, especially at the upper part of the bone, where it is sometimes rather indistinct. It inclines inwards inferiorly, and blends, in the lower 1-4th of the bone, with the oblique line, with which oblique line it ends at apex of triangular rough surface above articular facet of external malleolus.

POSTERO-EXTERNAL – Usually called POSTERIOR. – Well marked & prominent. Extends from styloid process to inner lip of groove on posterior border of external malleolus, being directed, in succession, outwards, backwards, backwards & inwards. It gives attachment to the septum between the peronei & the flexor muscles.

POSTERO-INTERNAL, OR OBLIQUE LINE – Commences at inner side of head, most marked in upper & middle parts of the bone. Blends in lower fourth with the antero-internal border or interosseous ridge, with which latter it ends at the apex of the triangular rough surface above articular facet of external malleolus

Surfaces – Are:

ANTERIOR – Very narrow above, rather broader & slightly grooved below; for extensor longus digitorum, extensor proprius pollicis peroneus tertius.

EXTERNAL – Broad, more or less grooved for peronei. Looks in succession forwards & outwards, outwards, backwards & outwards, and is continued inferiorly into the groove on back of external malleolus.

INTERNAL – Comprised between the antero-internal border or interosseous ridge and the postero-internal border or oblique line, and exists only in the upper 3-4ths of the bone. Rather narrow, but less so than the anterior surface, slightly grooved for tibialis posticus.

POSTERIOR – Comprised between the postero-external border & the oblique line. Broad, looking inwards below; for soleus & flexor longus pollicis. Presents towards its middle the nutrient foramen, which is directed downwards.

UPPER EXTREMITY, or HEAD — Small, pyramidal. Rough in front, externally, & behind respectively for:

peroneus longus & anterior ligament of superior tibio-fibular articulation;
tendon of biceps, & long external lateral ligament of knee-joint.
soleus, & posterior ligament of superior tibio-fibular articulation.

Prolonged upwards externally into the
Styloid process, for short external lateral ligament of knee-joint.
Presents internally a small
Articular facet looking upwards & inwards, which facet articulates with outer tuberosity of tibia.

LOWER EXTREMITY, or EXTERNAL MALLEOLUS — Rather larger than head, flattened from within outwards, and descends lower than internal malleolus. Presents:

Surfaces:

OUTER – Subcutaneous, convex, prolonged upwards between the divisions of the antero-external border.

INNER – Presents:

Above & in Front – Articular facet for astragalus, triangular with base upwards, convex from above downwards, surmounted by a small facet for tibia, above which is a rough triangular impression for interosseous ligament of inf. tib.-fib. articulation.

Below & Behind – Rough & deep depression for posterior fasciculus of external lateral ligament of ankle-joint.

Borders:

ANTERIOR – Thick & rounded, for anterior fasciculus of external lateral ligament of ankle-joint.

POSTERIOR – Broader, and marked by a groove for tendons of peronei.

Apex – Rounded, for middle fasciculus of external lateral ligament of ankle-joint.

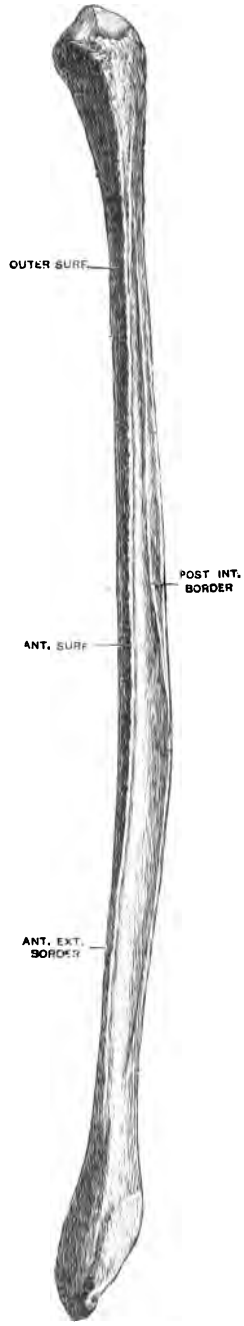


FIG. 128.—THE FIBULA FROM IN FRONT. (Morris.)

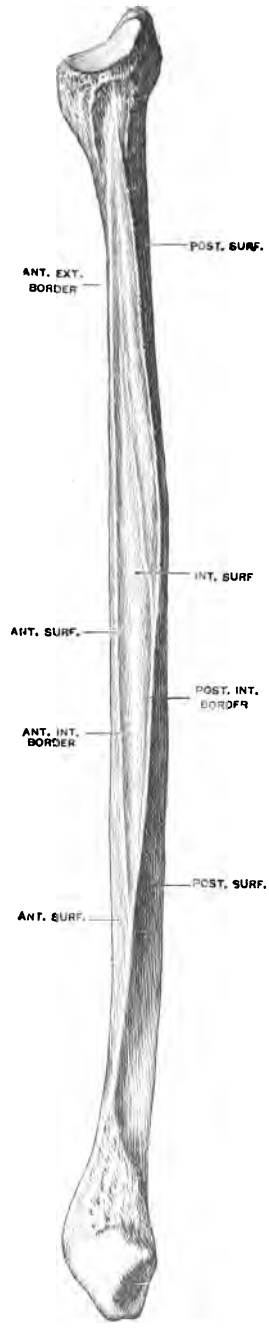


FIG. 129.—THE FIBULA FROM THE INNER SIDE.

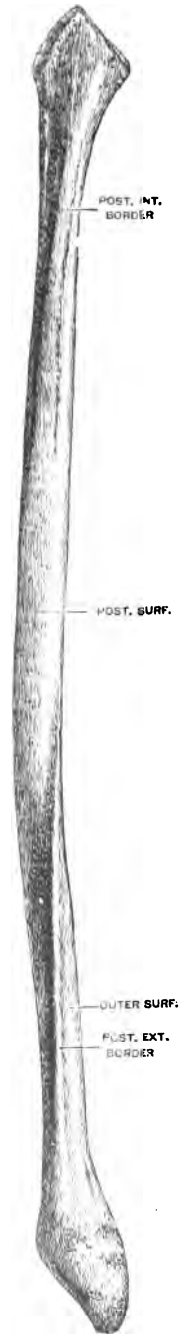


FIG. 130.—THE FIBULA FROM BEHIND. (Morris.)

THE FIBULA — 2nd Tablet.

OLD OR CLASSICAL DESCRIPTIONS OF THE SHAFT.

There are* in this country two different classical descriptions of the shaft of the fibula; the one is given by Holden, Quain, & Wilson; the other by Gray. Both descriptions recognise *three* borders & *three* surfaces, and, at first sight, they appear identical. They are far from being so, however, for of the three borders enumerated in both, there are but two that correspond, viz., the *anterior* & the *posterior* (antero-external & postero-external borders of the Author); and of the three surfaces, there is but one, the *external*, respecting which the descriptions agree.

Of the two ridges which exist on the inner aspect of the bone, the *interosseous ridge* & the *oblique line* (which ridges the Author has described respectively as the antero-internal & postero-internal borders), the latter ridge is taken as the inner border of the bone by Holden, Quain, & Wilson, while it is the former that is called the inner border by Gray.

This first & apparently slight difference brings about other & more important discrepancies in the delimitation & designation of the surfaces: — Thus we find on the inner aspect of the bone:

An Inner Surface & a Posterior Surface (Holden, Quain, Wilson);
An Anterior Surface & an Inner Surface (Gray);

Gray's "*Inner Surface*" surface being however very different from the "*Inner Surface*" of Holden, Quain, & Wilson, as will immediately appear: —

Holden, Quain, & Wilson's "Inner Surface" — Is the smallest of the three. It is bounded in front by the anterior border of the bone (antero-external border of the Author), and behind by the oblique line above mentioned. It is divided by the *interosseous ridge* into an "*anterior portion*" for extensor longus digitorum, extensor proprius pollicis & peroneus tertius, and a "*posterior portion*" for tibialis posticus.

Gray's "Inner Surface" — Is on the contrary the largest, and occupies nearly two-thirds of the circumference of the bone; it is bounded in front by the interosseous ridge, behind by the posterior border (postero-external border of the Author). It is divided by the *oblique line* into an "*anterior portion*" for tibialis posticus, (corresponding to the "*posterior portion*" of the former "*inner surface,*") and a "*posterior portion*" for soleus & flexor longus pollicis.

On the other hand

Holden, Quain, & Wilson's "Posterior Surface" (and the POSTERIOR SURFACE of the Author, for they are identical) — Are but the posterior part of the "INNER SURFACE" of Gray; — and

Gray's "Anterior Surface" (and the ANTERIOR SURFACE of the Author, for they are both the same) — Are but the anterior part of the "INNER SURFACE" of Holden, Quain, & Wilson.

It is with the hope of clearing up difficulties which have puzzled many, that the Author has presented a third & original description of the shaft of the fibula, and that he has ventured to compare & discuss the descriptions of the bone as given by eminent and well-known anatomists.

* There were up to 1890, as explained, page 125.

FIG. 130A.—THE RIGHT FIBULA: INNER VIEW, AS SHOWN IN THE LAST EDITION BUT ONE OF "QUAIN." 6 points to the "inner surface" of the bone, on which the *interosseous ridge* is shown.

The figure here given embodies the old or classical descriptions of the shaft of the Fibula

Up to the time of the last edition but one of "Quain" (1890), writers were endeavouring, under the influence of preconceived views, to describe only three surfaces to the shaft of the fibula, while there really are *four;* and, as it is natural under the circumstances, some set about the task in one way, and some in another.

The Author's description, – published in the Tablets in 1872, – has doubtless been improved by the very correct and elegant figures on page 123, which have been reproduced by kind permission of the Editors of "Morris's Anatomy."

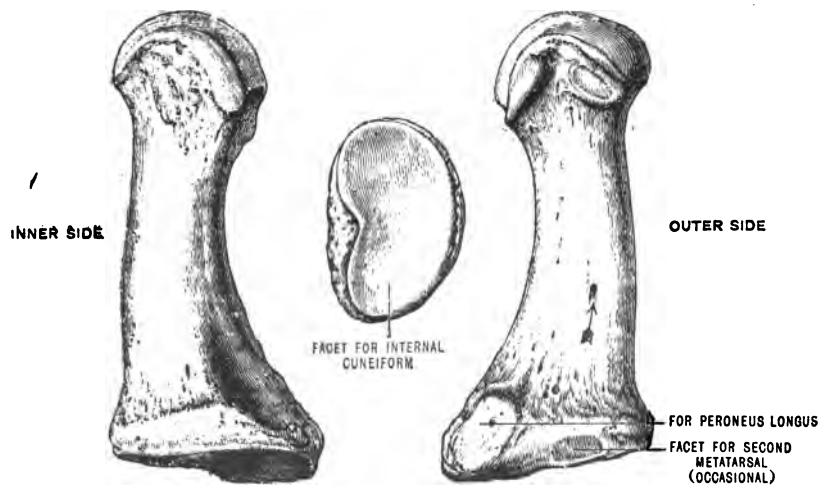


FIG. 131.—THE FIRST LEFT METATARSAL BONE. (Morris.)

THE ASTRAGALUS

Supports the tibia, rests upon the os calcis, articulates on either side with the malleoli & in front with scaphoid. Is irregularly cuboid, and presents six surfaces.

Upper Surface – Presents:

TROCHLEAR SURFACE – Broadest in front, convex from before backwards, slightly concave from side to side; in front of which surface is the

Upper Surface of the Neck – Rough for ligaments.

Under Surface – Presents:

Deep Groove – Directed forwards & outwards and broadest in front, for interosseous calcaneo-astragaloid ligament; this groove separates

TWO ARTICULAR FACETS – For os calcis; the posterior one, the largest, is concave; the anterior one, the smallest, is convex, continuous with the anterior articular surface and sometimes divided into two parts, one for lesser process of os calcis, one for calcaneo-scaphoid ligament.

Inner Surface – Presents:

TRIANGULAR ARTICULAR FACET – Small, continuous with trochlear surface, for internal malleolus; below this facet is a

Rough Groove – For deep portion of internal lateral ligament of ankle-joint.

Outer Surface – Presents:

TRIANGULAR ARTICULAR FACET – Much larger, concave from above downwards, also continuous with trochlear surface; in front of which is a

Deep Depression – For anterior fasciculus of external lateral ligament of ankle-joint.

Anterior Surface – Forms the

HEAD – Oval, oblique downwards & inwards, & convex for scaphoid, continuous inferiorly with anterior facet of under surface, and supported by a constricted part, the

NECK.

Posterior Surface – Very narrow, and represented merely by a slight

Groove – Oblique downwards & inwards for tendon of flexor longus pollicis.

THE OS CALCIS*

Irregularly cuboid; presents six surfaces.

Upper Surface – Presents from before backwards:

Upper Surface of Greater Process – Presenting a rough depresssion for extensor brevis digitorum;

TWO ARTICULAR SURFACES – For astragalus, and an intervening *deep groove* oblique forwards & outwards, and broadest in front for interosseous calcaneo-astragaloid ligament. – The posterior & external facet is convex, the largest, and situated on the body of the bone. The anterior or internal facet is concave, the smallest, and situated on the lesser process; it is sometimes divided into two.

Rough Saddle-shaped Surface – Belonging to the portion of the bone which projects backwards to form the heel.

Under Surface – Rough, convex from side to side, widest behind. Presents from behind forwards:

Two Tubercles – The internal, the largest, for abductor pollicis & flexor brevis digitorum; the external, the smallest, for abductor minimi digiti.

Rough Surface – For outer head of flexor access. & long calcaneo-cuboid ligt.

Tubercle & Transverse Groove – For short calcaneo-cuboid ligament.

Inner Surface – Concave for passage of vessels, nerves, & flexor tendons. Gives attachment to inner head of flexor accessorius, and is surmounted by the

LESSER PROCESS, OR SUSTENTACULUM TALI – Which articulates above with the astragalus, is grooved inferiorly for tendon of flexor longus pollicis, and gives attachment by its inner margin to a part of the superficial fibres of the internal lateral ligament of the ankle-joint.

Outer Surface – Presents towards its middle a

Tubercle – For middle fasciclus of external lateral ligament of ankle-joint; and in front of the tubercle,

Two Grooves – Separated by a slight ridge for tendons of peronei.

Anterior Surface – Concavo-convex for articulation with cuboid; is surmounted externally by a rough prominent tubercle which is an important guide in Chopart's amputation.

Posterior Surface – Rough & broad below for insertion of tendo Achillis & plantaris muscle, narrow & smooth above, where it is covered by a bursa.

* See Figs. 146 and 147, p. 134.

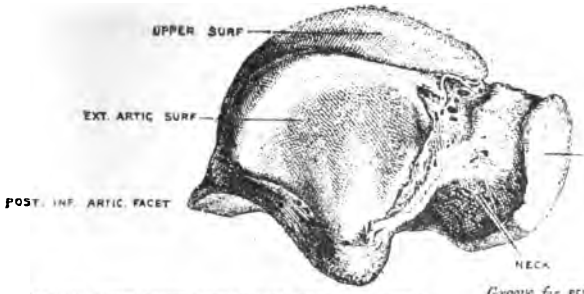


FIG. 132.—THE RIGHT ASTRAGALUS, FROM THE OUTER SIDE. (Sappey.)

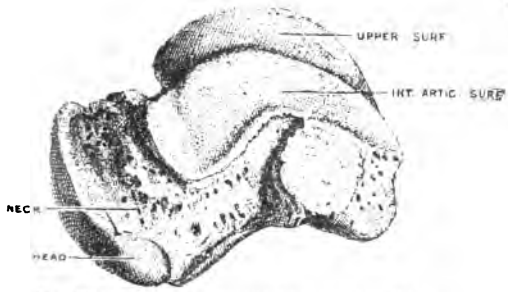


FIG. 133.—THE RIGHT ASTRAGALUS, FROM THE INNER SIDE. (Sappey.)

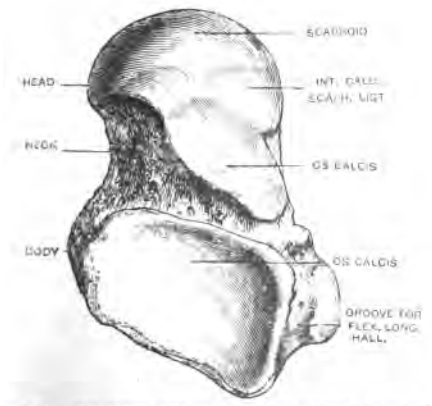


FIG. 134.—THE RIGHT ASTRAGALUS, FROM BELOW. (Wilson.)

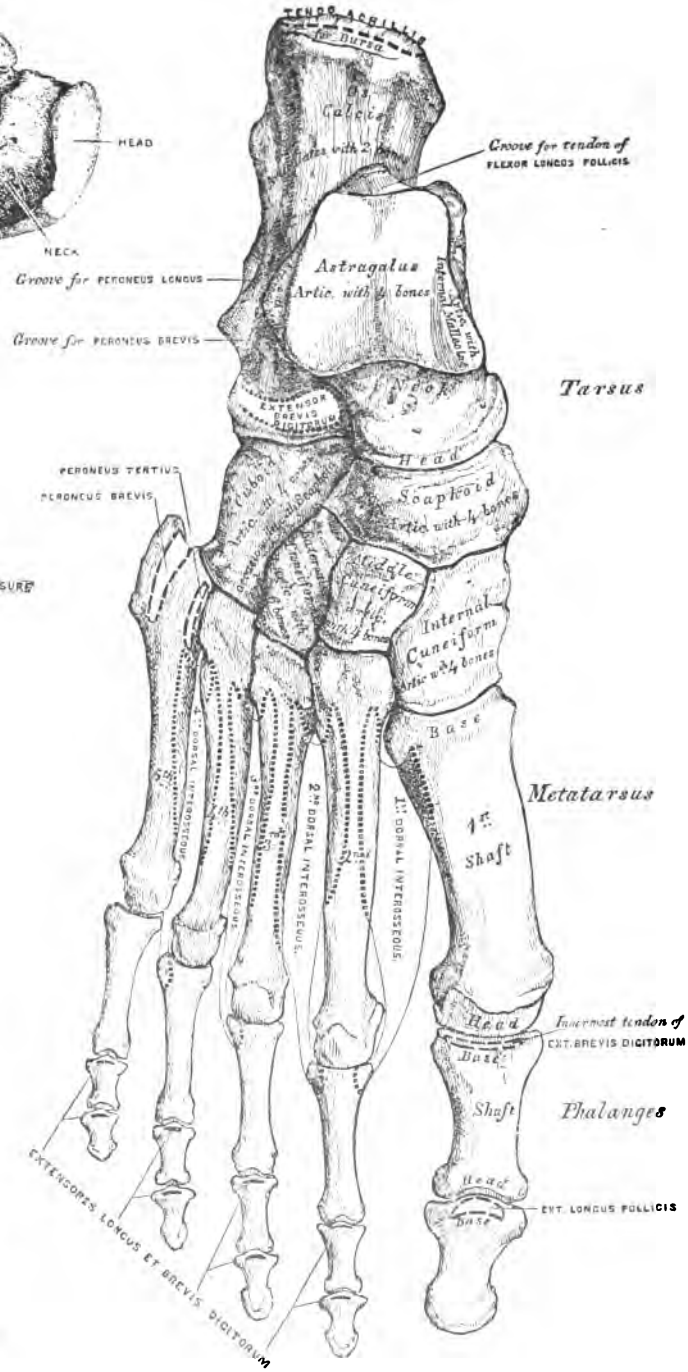


FIG. 135.—BONES OF THE RIGHT FOOT: DORSAL SURFACE. (Gray)

FIG. 136.—THE SCAPHOID: ANTERIOR VIEW. (Morris.)

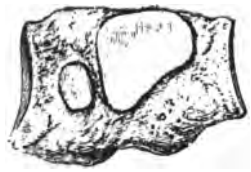


FIG. 137.—THE LEFT CUBOID: INNER VIEW. (Morris.)

(Both with the corresponding occasional facet.)

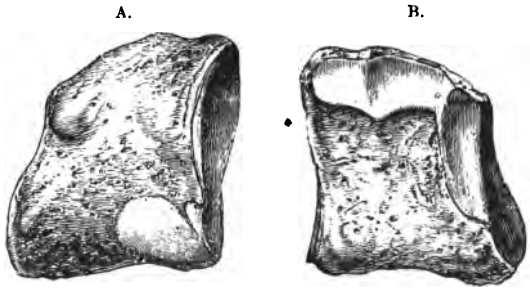


FIG. 138.—THE LEFT INTERNAL CUNEIFORM: A, INNER VIEW; B, OUTER VIEW. (Morris.)

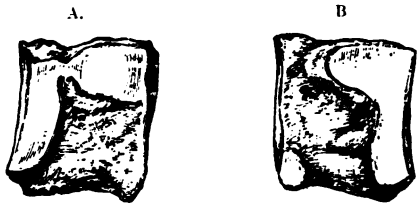


FIG. 139.—THE LEFT MIDDLE CUNEIFORM: A, INNER VIEW; B, OUTER VIEW. (Morris.)

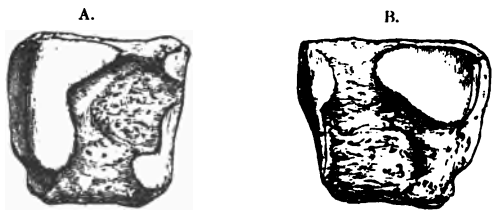


FIG. 140.—THE LEFT EXTERNAL CUNEIFORM: A, INNER VIEW; B, OUTER VIEW. (Morris.)

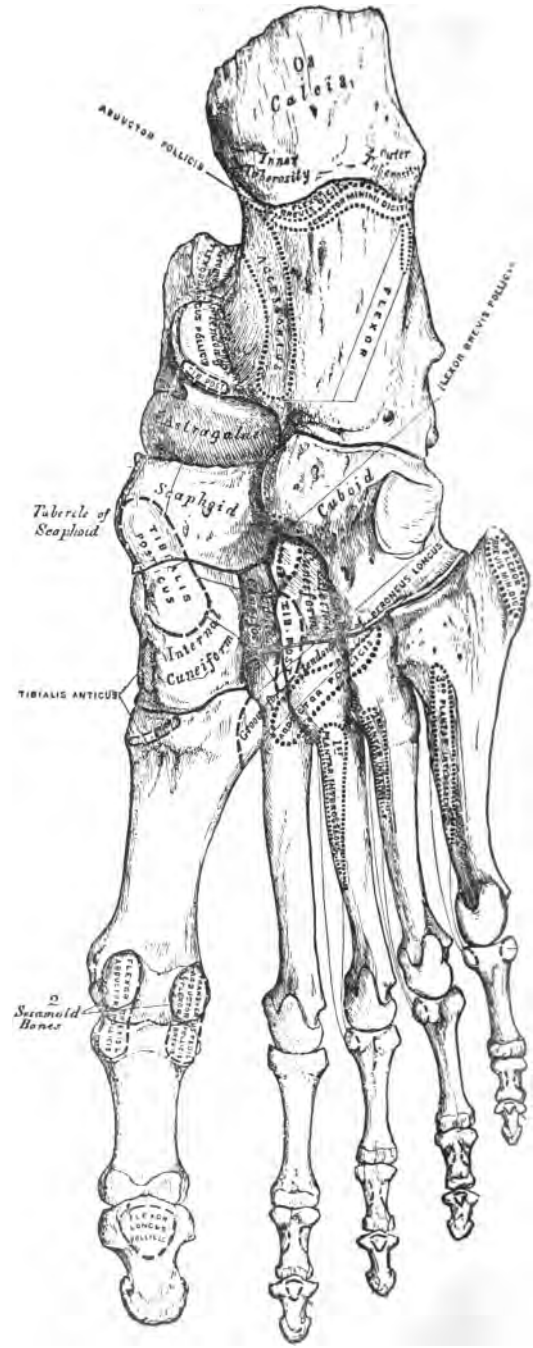


FIG. 141.—BONES OF THE RIGHT FOOT: PLANTAR SURFACE. (Gray.)

THE SCAPHOID*— Presents:

ANTERIOR SURFACE – Convex, broadest externally; presents
three triangular facets for the cuneiform.
POSTERIOR SURFACE – Concave, for head of astragalus, also broadest externally.
CIRCUMFERENCE – Rough, convex above, concave below. Presents below & internally a
tubercle, for tendon of tibialis posticus; and sometimes externally a
facet, for cuboid.

THE CUBOID — Presents:

Articular Surfaces – Three:

ANTERIOR – Presents two facets,
inner, smaller, quadrilateral for 4th metatarsal,
outer, larger, triangular for 5th metatarsal.
POSTERIOR – Quadrilateral, concavo-convex for os calcis.
INTERNAL – Presents towards middle & upper part a
large anterior facet for external cuneiform; and sometimes behind this a
smaller posterior facet for scaphoid. – The remainder of this surface is rough for ligaments.

Non-Articular Surfaces – Three:

SUPERIOR – Rough, oblique downwards & outwards.
INFERIOR – Presents from before backwards:
deep groove oblique forwards & inwards, which transmits tendon of peroneus longus, and is bounded behind by a prominent
ridge for long calcaneo-cuboid ligament, which ridge begins externally in a prominent
tubercle presenting a small facet for a sesamoid bone;
rough surface for short calcaneo-cuboid ligament, and part of the flexor brevis pollicis.
OUTER – A mere border notched by commencement of peroneal groove.

THE CUNEIFORM BONES

Three, wedge-shaped, & six sided. All three present

COMMON CHARACTERS:

DORSAL SURF. – Quadrilateral, and rough for ligaments. Looks obliquely inwards in the internal cuneiform, in which bone it also presents a small groove or facet for tendon of tibialis anticus.
PLANTAR SURF. – Rough rounded border in the two outermost. In the innermost it is a broad rough surface marked behind by a tubercle for the tibialis posticus.
POSTERIOR SURF. – Triangular & concave from above downwards. They articulate with the three facets on anterior surface of scaphoid, and lie in the same transverse line.
ANTERIOR SURF. – Triangular in the two outermost, kidney-shaped in the innermost; they articulate with the bases of the three innermost metatarsal bones. These surfaces present an indented outline; the middle cuneiform being shorter than the two others, its anterior surface is depressed.
LATERAL SURF. – Articulate with each other, the cuboid, both sides of the base of the 2nd metatarsal bone & the inner side of the base of the 4th; the lateral surfaces of the 3rd cuneiform presenting each of them two facets, and the adjoining surfaces of the 1st & 2nd presenting a facet angular in shape & running along the superior & posterior borders. The inner surface of the internal cuneiform is a mere rounded border.

DISTINCTIVE CHARACTERS

BETWEEN THE THREE BONES.
FIRST – Larg size, irregular form, anterior kidney-shaped surface, facet for tibialis anticus, tubercle for tibialis posticus.
SECOND – Small size, square-shape of dorsal surface, angular articular facet along the upper & back part of its inner surface.
THIRD – Intermediate size, two facets on both of its lateral surfaces.
BETWEEN THE BONES OF THE TWO SIDES – Are evident in the case of the first & second cuneiform. To have the three points necessary to place the third one in position all that is requisite is to remark that the ant. internal facet is rather larger than the ant. external

* See Fig. opposite, and also Fig. 148, p. 134.

THE METATARSAL BONES.

Long bones with shaft & two extremities.

COMMON CHARACTERS:

Shaft – Prismoid, concave inferiorly, slightly tapering towards digital end. Present:
DORSAL SURFACE – Triangular, pretty well marked behind, but reduced to a mere border in greatest part of its extent, covered by extensor tendons.
LATERAL SURFACES – Divided by a ridge into two parts for plantar & dorsal interossei.

Tarsal Extremity or Base – The largest; cuboid. Presents:
DORSAL & PLANTAR SURFACES – Rough, the former of which is the largest.
POSTERIOR & LATERAL SURFACES – Artic. with bones of tarsus & adjoining metatarsal bs.

Digital Extremity or Head – Smaller, compressed from side to side. Presents:
ANT. OR ARTICULAR SURFACE – Rounded, extending farther backwards below than above.
LATERAL SURFACES – Depressed; present a prominent tubercle for lateral ligament of corresponding metatarso-phalangeal articulation.
PLANTAR SURFACE – Narrow; grooved for flexor tendons.
DORSAL SURFACE – Narrow & flat.

PARTICULAR CHARACTERS:

FIRST METATARSAL BONE — The shortest & much the thickest.
SHAFT – Very thick & strong.
TARSAL EXTREMITY – Presents a large semilunar facet for internal cuneiform, but has no lateral articular facets. It is prolonged below & externally into a prominent tubercle for tendon of peroneus longus.
DIGITAL EXTREMITY – Large & broad. Presents inferiorly two grooved facets for sesamoid bs.

SECOND METATARSAL BONE — The longest; received posteriorly into the recess between the three cuneiform bones.
TARSAL EXTREMITY – Presents:
Tarsal Facet – Triangular, for middle cuneiform.
Lateral Facets – Three: – One internal for internal cuneiform; two external for external cuneiform & 3rd metatarsal. These two latter facets are often divided into upper & lower halves by a rough horizontal groove for an interosseous ligt.

THIRD METATARSAL BONE — A little shorter.
TARSAL EXTREMITY – Presents:
Tarsal Facet – Triangular, for external cuneiform.
Lateral Facets – Two: – One internal & one external for 2nd & 4th metatarsal bs.; the former facet is often divided into upper & lower halves by an interosseous groove.

FOURTH METATARSAL BONE — The shortest but one.
TARSAL EXTREMITY – Presents:
Tarsal Facet – Quadrilateral, for cuboid.
Lateral Facets – Three: – One ext. for 5th metatarsal, two int. for 3rd metatarsal & external cuneiform; the facet for the external cuneiform being sometimes absent.

FIFTH METATARSAL BONE — The shortest.
TARSAL EXTREMITY – Presents:
Tarsal Facet – Triangular, cut obliquely forwards & inwards, for cuboid;
Internal Lateral Facet – For 4th metatarsal;
Prominent External Tubercle – For peroneus brevis.

N.B. — The foregoing characters supply the three points requisite to place the bones in position, and therefore to distinguish between right bones and left bones.

THE PHALANGES.

Fourteen; three, which are smaller than corresponding phalanges of hand, to the four outer toes, two, which are larger than corresponding phalanges of hand, to the big toe. Are long bones, and present:

Shaft – Slightly curved inferiorly, compressed from side to side & narrowed towards middle. Convex from side to side on dorsal surf.; flat on plantar surf., which is very narrow & bounded by two prominent margins for attachment of sheaths of flexor tendons. – The shaft is longer in first or proximal phalanges than in second, in second than in third. It is exceedingly short in second phalanges of 4th & 5th toes.

Proximal Extremity – The largest. Presents:
IN FIRST ROW – Oval, concave, articular surface, broadest from side to side.
IN SECOND & THIRD ROWS – Two lateral concavities & a median ridge.

Distal Extremity – The smallest. Presents:
IN FIRST & SECOND ROWS – A trochlear surface prolonged farther backwards below than above.
IN THIRD ROW – A rough horse-shoe shaped eminence on plantar surface.

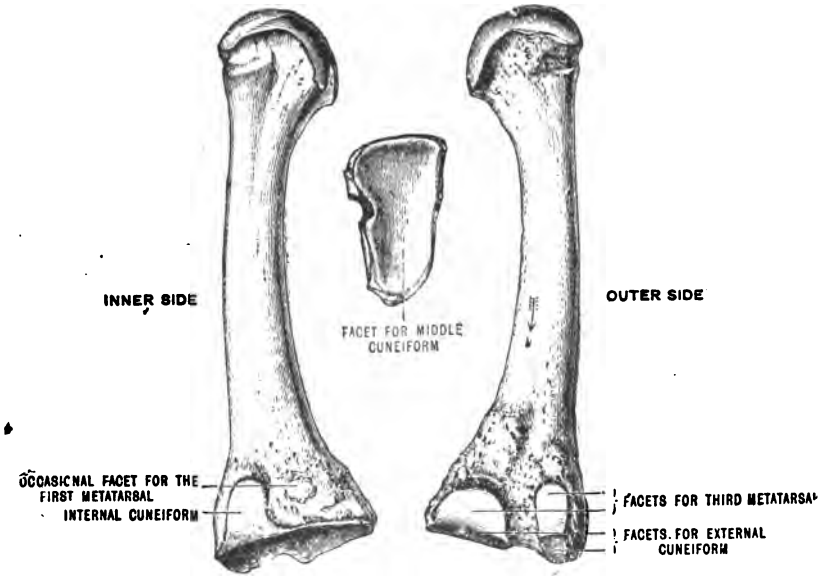


FIG. 142.—THE SECOND LEFT METATARSAL BONE. (Morris.)

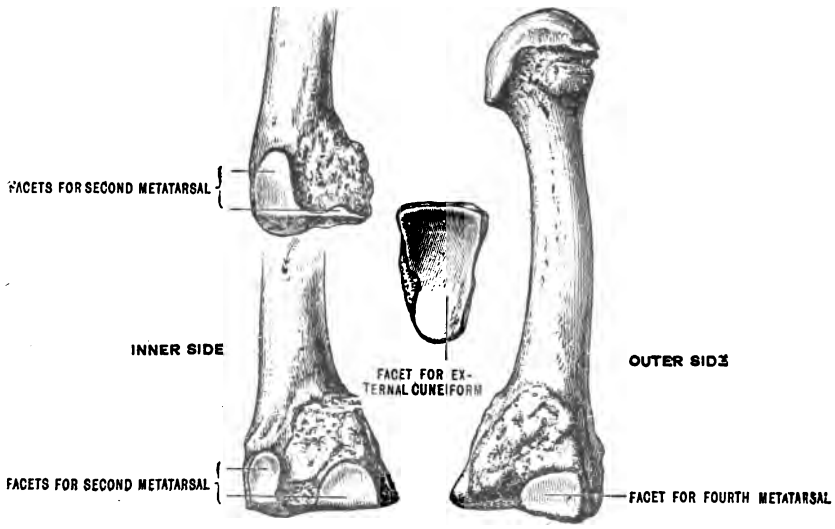


FIG. 143.—THE THIRD LEFT METATARSAL BONE. (Morris.)

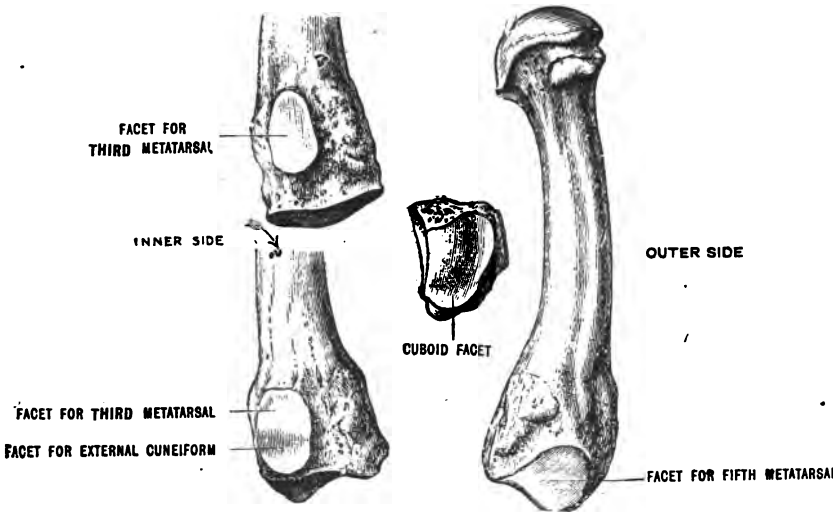


FIG. 144.—THE FOURTH LEFT METATARSAL BONE. (Morris.

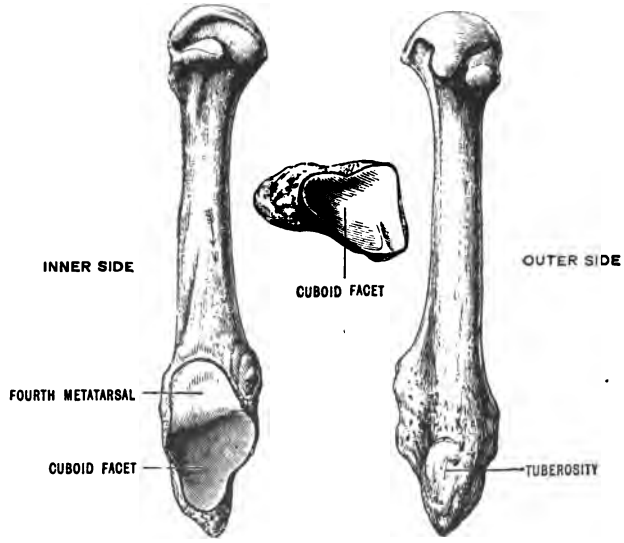


FIG. 145.—THE FIFTH LEFT METATARSAL BONE. (Morris.

THE PATELLA.

Flat, triangular, situated at front of knee-joint. Is regarded by some as a sesamoid bone developed in tendon of quadriceps extensor femoris, by others as the homologue of the olecranon. Presents two surfaces, three borders, & an apex.

SURFACES — Are:

Anterior – Subcutaneous, convex, marked by rough vertical striæ, & perforated by numerous vascular foramina; is covered by an expansion of tendon of quadriceps, the fibres of which expansion are continuous with superficial fibres of ligamentum patellæ.

Posterior – Divided into:

Upper or Articular Portion – Corresponds to upper three-fourths of the surface, and is divided by a prominent vertical ridge into two concave facets, of which the inner one, the smallest & shallowest, is further diminished by a slightly marked vertical ridge, which vertical ridge cuts off a narrow marginal portion corresponding to the inner border of the bone; this marginal portion comes in contact during flexion of the knee-joint with the inner border of the intercondyloid notch (Lenoir, Goodsir). – In well marked bones the two concave facets are divided by two transverse ridges into three horizontal bands, which rest in succession upon the femoral trochlea during the movements of flexion & extension of the joint (Goodsir).

Lower or Non-articular Portion – The lower fourth; forms a rough transverse groove for attachment of greater part of ligamentum patellæ.

BORDERS — Are:

Superior – Thick, cut obliquely at expense of anterior surface, for tendons of rectus & crureus.

Lateral – Thinner, converging inferiorly, for tendons of vasti & capsule of knee-joint. – The inner border is marked posteriorly by the small marginal facet above mentioned

APEX — Directed downwards; forms part posteriorly of rough groove above mentioned for ligamentum patellæ

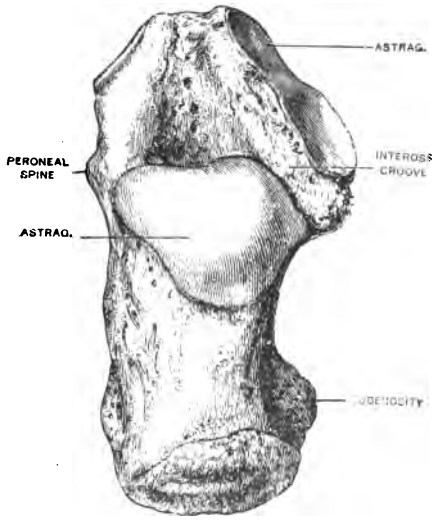


FIG 146.—THE LEFT OS CALCIS, FROM ABOVE. (Morris.)

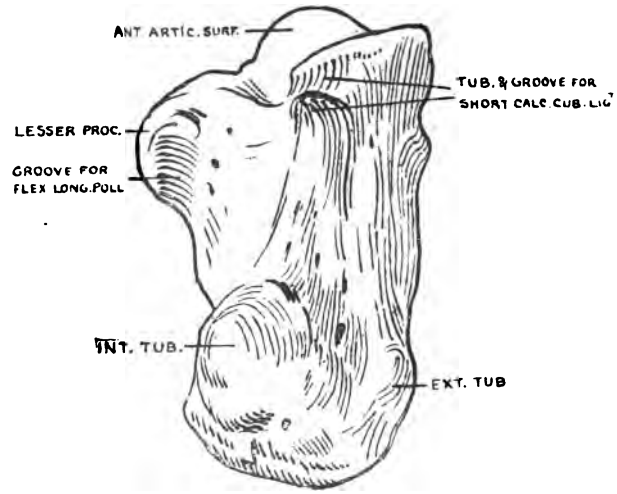


FIG. 147.—THE LEFT OS CALCIS, FROM BELOW.

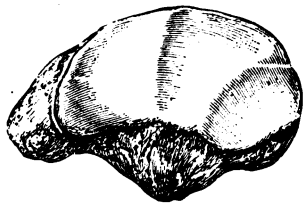


FIG. 148.—THE LEFT SCAPHOID FROM IN FRONT. (Morris.)

FIG. 149,—THE THREE RIGHT CUNEIFORM BONES, FROM BEHIND. (Sappey.)

FIG. 150.—THE THREE RIGHT CUNEIFORM FROM IN FRONT. (Sappey.)

FIG. 151.—THE RIGHT PATELLA. A, ANTERIOR SURFACE; B, POSTERIOR SURFACE. (Gray.)

THE DEVELOPMENT OF THE BONES.

OSSIFICATION of the THORACIC and PELVIC LIMB-GIRDLES—1st Tablet.

SCAPULA.

One Primary Centre for Body - A little behind glenoid cavity, 7th or 8th week. Soon expands into a triangular plate, from upper & back part of which the spine arises as a transverse ridge about 3rd month.

Six Secondary Centres - For

MIDDLE OF CORACOID PROCESS - 1st year; joins with remainder of the bone about 14th or 16th year.

About the same time there appear in quick succession five centres for

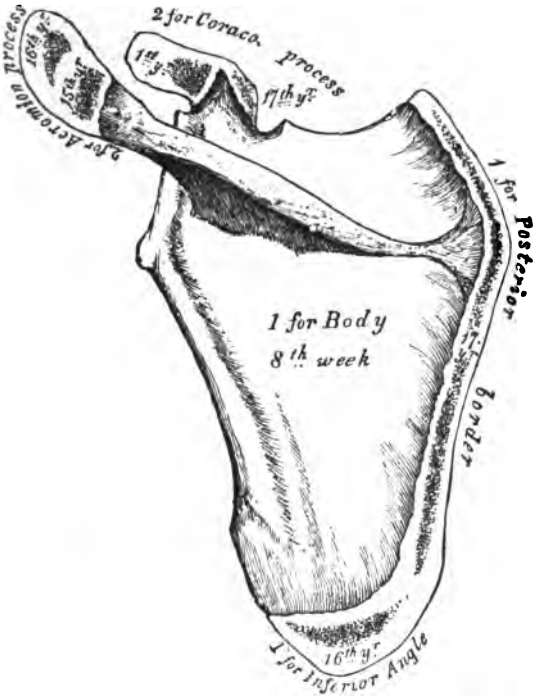
BASE OF ACROMION,
TIP OF ACROMION,
LOWER ANGLE, & LOWER PART OF POSTERIOR BORDER,
BASE OF CORACOID PROCESS,
REMAINDER OF POSTERIOR BORDER.

All these epiphyses join with body between 22nd & 25th years.

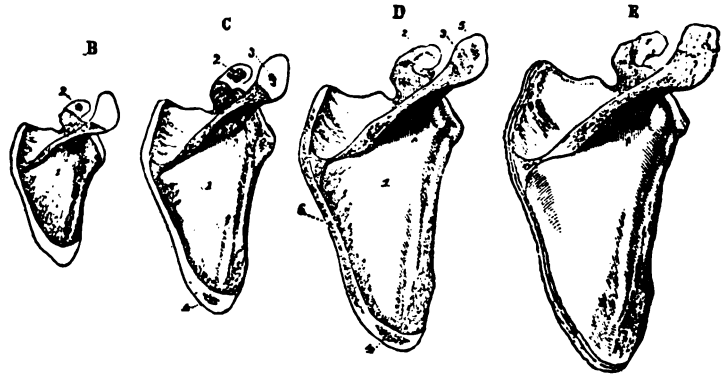
Another epiphysial lamina is sometimes developed in *margin of glenoid cavity.*

CLAVICLE - Vide *Long Bones with one Epiphysis.*

FIG. 152.—DEVELOPMENT OF THE SCAPULA. (A, Gray; B to E, Quain.)



The epiphyses (except one for the coracoid Process) appear from 15 to 17 years, and unite between 22 and 25 years of age.



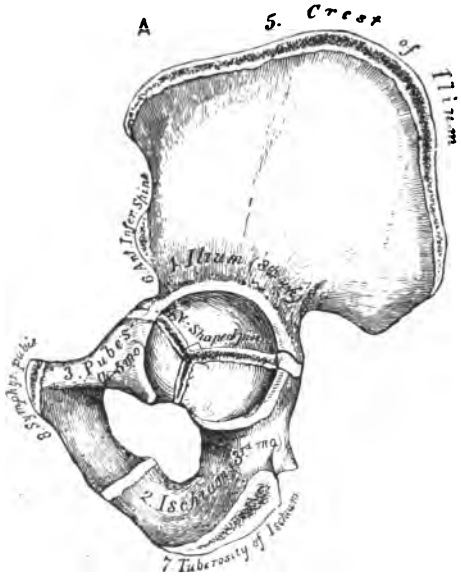
B, the scapula from a child of about *one year old*. 1, shows the large spreading ossification from the primary centre; 2, the commencing nucleus in the coracoid process.

C, the scapula from a boy of about 15 *or* 16 *years*. *The coracoid process is now partially united at its base;* a nucleus, 3, has appeared in the acromion, and another, 4, at the lower angle.

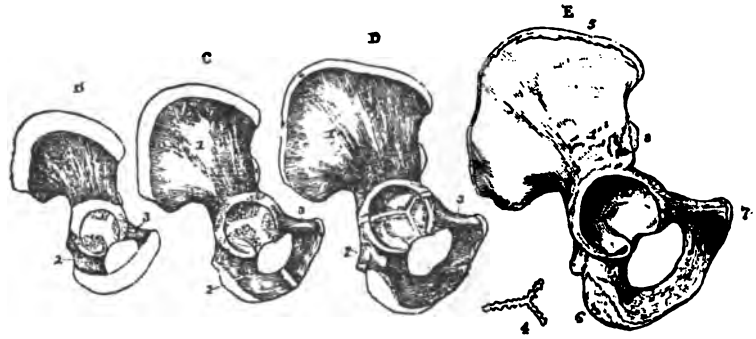
D, shows the condition of the scapula at 17 *or* 18 *years* of age; *a second point*, 5, *has appeared in the acromion*, and ossification has advanced into the ridge of the base, 6.

E, the scapula of a man of about 22 *years of age;* the acromion and the ridge of the base are still separate. A thin scale on the coracoid process and an epiphysis of the glenoid head, which sometimes occur, have been omitted.

FIG. 153.—DEVELOPMENT OF THE INNOMINATE BONE. (A, Gray; B to E, Quain.



3, primary centres (ilium, ischium, pubes).
5, secondary.
The three primary centres unite through Y-shaped piece (os acetabuli) appearing about puberty. Epiphyses appear about puberty, and unite about 25th year.



B, the condition of the bone at birth. Bone has spread from three nuclei into the ilium, ischium, and pubis, which meet in the cartilage of the acetabulum.

C, from a child under six years of age The rami of the ischium and pubis are farther ossified, but still separate.

D, a bone of two or three years later, in which the rami are united.

E, the bone from a person of about 20 years. Union has taken place in the acetabulum, and the additional epiphyses are seen in the crest of the ilium, the anterior inferior spine, the ischial tuberosity, and the margin of the symphysis pubis.

In B, C, and D, 1, ilium; 2, ischium; 3, pubis; below, E, 4, separated Y-shaped piece formed of several fragments which begin to ossify about the 14th year, and often unite into this form before the completion of the acetabulum; 5, epiphysis of the crest; 6, that of the tuberosity of the ischium; 7, that of the symphysis pubis; 8, that of the anterior inferior spine of the ilium

OSSIFICATION of the THORACIC and PELVIC LIMB-GIRDLES—2nd Tablet.

INNOMINATE BONE.

Three Primary Centres - For

ILIUM - A little above great sacro-sciatic notch; 8th or 9th week.
ISCHIUM - In body; 3rd month.
PUBES - In horizontal ramus; 4th or 5th month.

At birth, processes of osseous tissue have extended into the acetabulum from each of the three parts of the bone. These processes, though growing towards centre of acetabulum and towards each other, remain separated by a Y-shaped piece of cartilage till some time after 13th or 14th year, *i.e.*, for some time after appearance in this piece of cartilage of first of the secondary points of ossification.

The rami of the pubes & ischia are incompletely ossified till about 6th year; they are joined together about 7th or 8th year.

Five Secondary Centres - Appearing about 13th or 14th year, for

Y-SHAPED PIECE OF CARTILAGE AT BOTTOM OF ACETABULUM.

This piece, when ossified, connects, about 17th or 18th year, first ilium to ischium, then both the former to pubes; the ilium forming rather less than $\frac{3}{5}$ths, the ischium rather more than $\frac{1}{5}$ths, and the pubes the remaining $\frac{1}{5}$th of the acetabulum. - This Y-shaped piece is sometimes ossified from several centres.

CREST & ANTERO-INFERIOR SPINE OF ILIUM
TUBEROSITY OF ISCHIUM
SYMPHYSIS PUBIS
} These epiphyses join with remainder of the bone about 25th year.

Both in the fœtus and the young child, the pelvis is much more oblique, and of much smaller capacity than it is in the adult: The bladder in both sexes, and the uterus in the female, lie partly above the brim.

OSSIFICATION of LONG BONES with TWO EPIPHYSES – 1st Tablet.

BONES OF UPPER LIMB.

HUMERUS - Seven centres, sometimes eight, – for

Shaft - 8th week.
Head – 1st or 2nd year.
Greater Tuberosity - 3rd year.

The *Lesser Tuberosity* is ossified either by extension of osseous tissue from greater tuberosity, or from a separate centre which appears in 5th year. In this same year the *centres for the head & tuberosities* are united into one epiphysis, which is joined to the shaft about 21st year.

Capitellum, & Outer Portion of Trochlea – 2nd or 3rd year.
Inner Condyle – 5th year.
Inner Portion of Trochlea – 11th or 12th year.
Outer Condyle – 13th or 14th year.

The *outer condyle & the two portions of inferior articular surface* unite to form one epiphysis, which is joined to the shaft about 16th or 17th year.

The *inner condyle* forms a separate epiphysis, which is joined to the shaft about 18th year.

RADIUS - Three centres, for

Shaft - 8th week, a little after humerus.
Lower Epiphysis – 2nd or 3rd year.
Upper Epiphysis – 5th year.

These epiphyses are joined to the shaft as follows: -
UPPER EPIPHYSIS – 17th or 18th year.
LOWER EPIPHYSIS – 20th year.

ULNA - Three centres, for

Shaft – 8th week, a little after radius.
Lower Epiphysis – For head & styloid process, 4th or 5th year.
Upper Epiphysis – For extremity of olecranon, 10th year. Coronoid process, and all but extremity of olecranon, is formed by extension of osseous tissue of shaft.

These epiphyses are joined to the shaft as follows: -
UPPER EPIPHYSIS – 16th year.
LOWER EPIPHYSIS – 20th year.

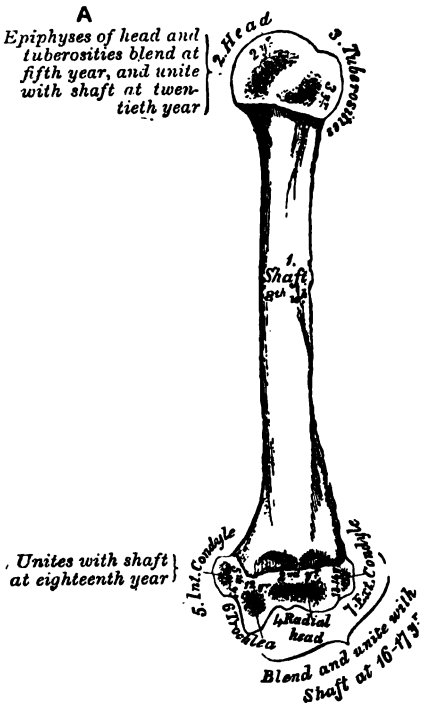
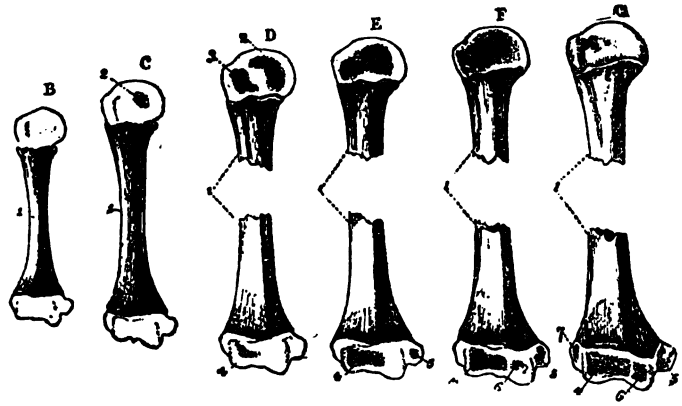

A
Epiphyses of head and tuberosities blend at fifth year, and unite with shaft at twentieth year
2. Head
3. Tuberosities
1. Shaft
Unites with shaft at eighteenth year
5. Int. Condyle
4. Trochlea
4. Radial head
Blend and unite with Shaft at 16-17 yr.

FIG. 154.—DEVELOPMENT OF THE HUMERUS. (A, Gray; B to G, Quain.)



B, humerus of a full-grown fœtus; C, humerus at two years of age; D, in the third year; E, at the beginning of the fifth year; F, at about the 12th year; G, at the age of puberty.

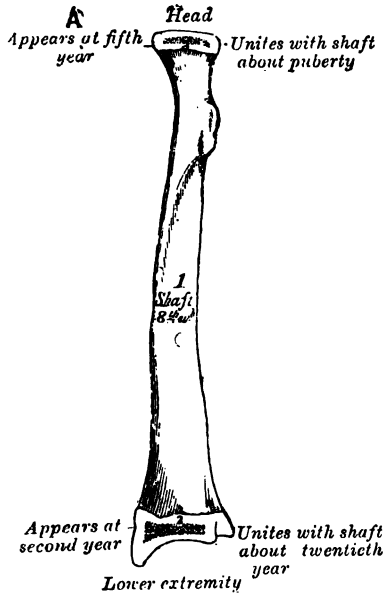
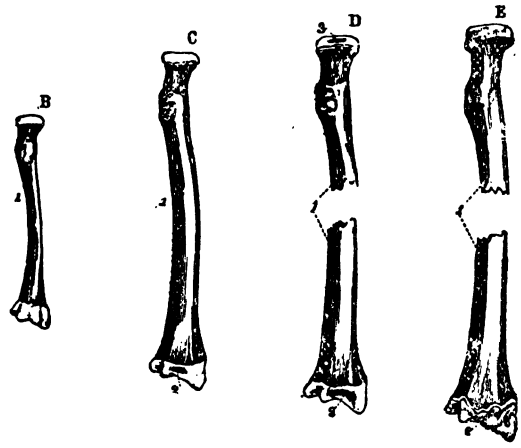


FIG. 155.—DEVELOPMENT OF THE RADIUS. (A, Gray; B to E, Quain.)



B, the radius of a full-grown fœtus; C, the radius at about two years of age; D, at five years; E, at about 18 years.

In E, the upper epiphysis is already united to the shaft while the lower epiphysis is still separate.

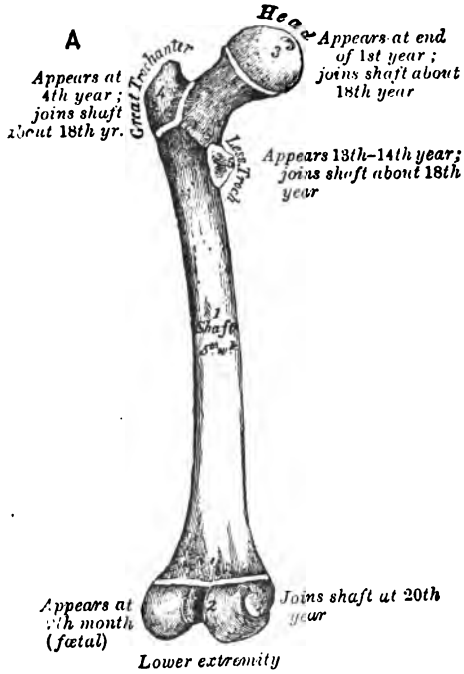
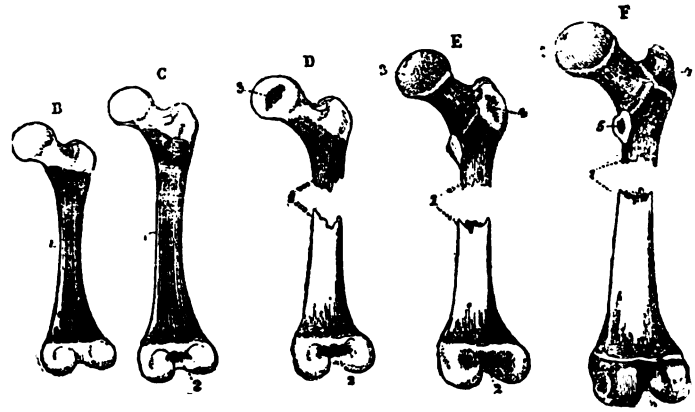

A
Head
Appears at end of 1st year; joins shaft about 18th year
Great Trochanter
Appears at 4th year; joins shaft about 18th yr.
Lesser Trochanter
Appears 13th–14th year; joins shaft about 18th year
Shaft
Appears at 7th month (fœtal)
Joins shaft at 20th year
Lower extremity

FIG. 156. – DEVELOPMENT OF THE FEMUR. (A, Gray; B to F, Quain.)



B, femur of a fœtus of about eight months; the body is osseous; both ends are cartilaginous.

C, femur of a child *at birth*, showing a nucleus in the lower epiphysis.

D, femur of a child of about *a year* old, showing a nucleus in the articular head.

E, femur of the *fifth or sixth year*. Ossification has extended from the shaft into the neck, and a nucleus has appeared in the great trochanter.

F, femur of about the age of *puberty*, showing more complete ossification and a nucleus in the lesser trochanter.

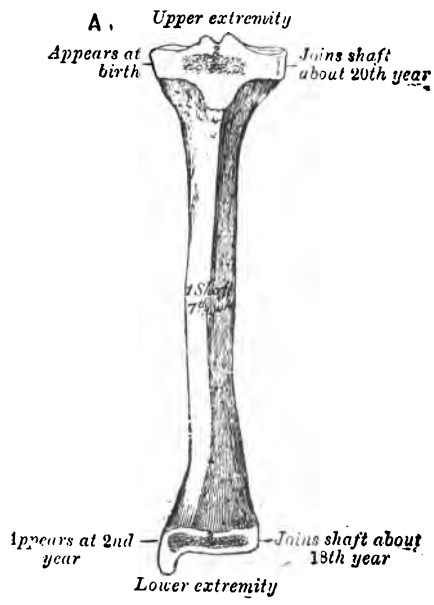
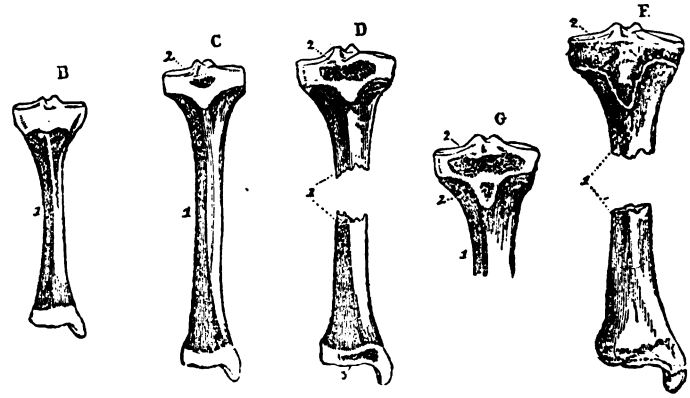


FIG. 157.—DEVELOPMENT OF THE TIBIA. (A, Gray; B to G, Quain.)



B, some weeks before birth; the shaft is ossified; the ends are cartilaginous.

C, at birth, showing the commencement of a nucleus in the upper epiphysis.

D, at the third year, showing the nucleus of the lower epiphysis.

E, at about 18 or 20 years, showing the lower epiphysis united, while the upper remains separate. The upper epiphysis is seen to include the tubercle.

G, shows an example of a separate centre for the tubercle.

OSSIFICATION of LONG BONES with TWO EPIPHYSES— 2nd Tablet.

BONES OF LOWER LIMB.

FEMUR – Five Centres, for

Shaft – 6th week, – before any other long bone except clavicle. – The *neck* is formed by extension of osseous tissue of shaft.
Lower Epiphysis – For condyles & tuberosities, 9th month.
Head – 1st year after birth.
Great Trochanter – 4th year.
Lesser Trochanter – 13th or 14th year.

These epiphyses & apophyses are joined to the shaft as follows: –

LESSER TROCHANTER – 17th year.
GREATER TROCHANTER – 18th year.
HEAD – 19th year.
LOWER EPIPHYSIS – 20th year.

TIBIA – Three centres, for

Shaft – 7th week.
Upper Epiphysis – For tubercle & both tuberosities, 1st year.
Lower Epiphysis, including *Internal Malleolus* – 2nd year.

These epiphyses are joined to the shaft as follows: –

LOWER EPIPHYSIS – 18th year.
UPPER EPIPHYSIS – 20th year.
There are occasionally separate centres for *Tubercle* & *Internal Malleolus*

FIBULA – Three centres, for

Shaft – 8th week.
Lower Epiphysis – 2nd year.
Upper Epiphysis – 4th year.

These epiphyses are joined to the shaft *in the order of their appearance*

LOWER EPIPHYSIS – 20th year.
UPPER EPIPHYSIS – 25th year.

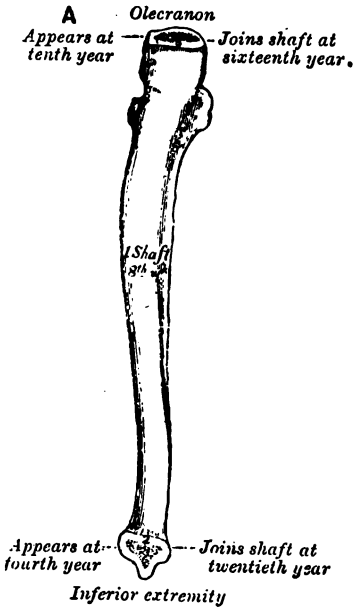
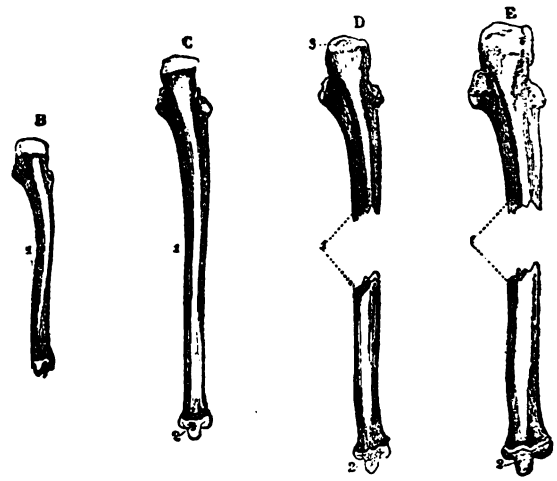


FIG. 158.—DEVELOPMENT OF THE ULNA. (A, Gray; B to E, Quain.)



B, the ulna of a child at birth; C, the ulna of a child at the end of the fourth year; D, of a boy of about 12 years of age; E, the ulna of a male of about 19 or 20 years.

In E, the upper epiphysis is united to the shaft, while the lower one is still separate.

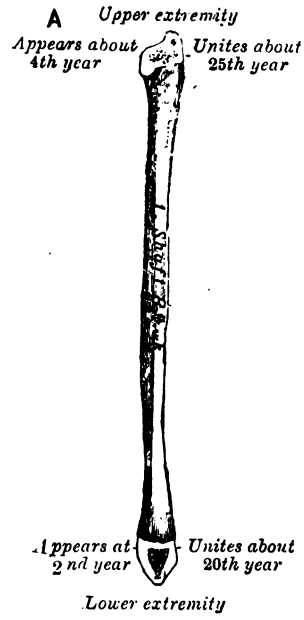
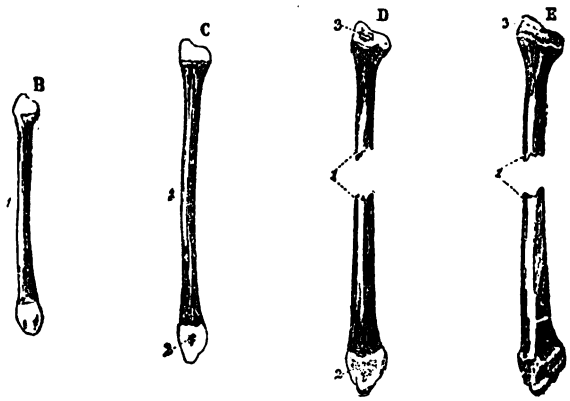


FIG. 159.—DEVELOPMENT OF THE FIBULA. (A, Gray; B to E, Quain.)



B, at birth. The shaft ossified; the ends cartilaginous.

C, at two years, showing a nucleus in the lower epiphysis.

D, at about four years, showing the nucleus of the upper epiphysis; the lower ought to have been shown as more advanced.

E, at about 20 years; the lower end is complete, but the upper epiphysis is still separate.

1, shaft; 2, lower epiphysis; 3, upper epiphysis.

OSSIFICATION of the LONG BONES with ONE EPIPHYSIS ONLY.

CLAVICLE - Two centres, for

SHAFT - 5th week, before any other bone. The ossification commences before deposition of cartilage, but afterwards progresses in cartilage as well as in fibrous tissue.

STERNAL END - 18th or 20th year. Joins with shaft about 25th year.

METACARPAL & METATARSAL BONES & PHALANGES - Two centres, for

SHAFT - 8th or 9th week; a little later in phalanges of toes.

DISTAL EXTREMITY OF FOUR INNER METACARPALS & FOUR OUTER METATARSALS
PROXIMAL EXTREMITY OF PHALANGES, & OF 1ST METACARPAL & 1ST METATARSAL
} 3rd to 8th year, or a little later in phalanges of toes.

All these epiphyses unite with the shaft from 18th to 21st year.

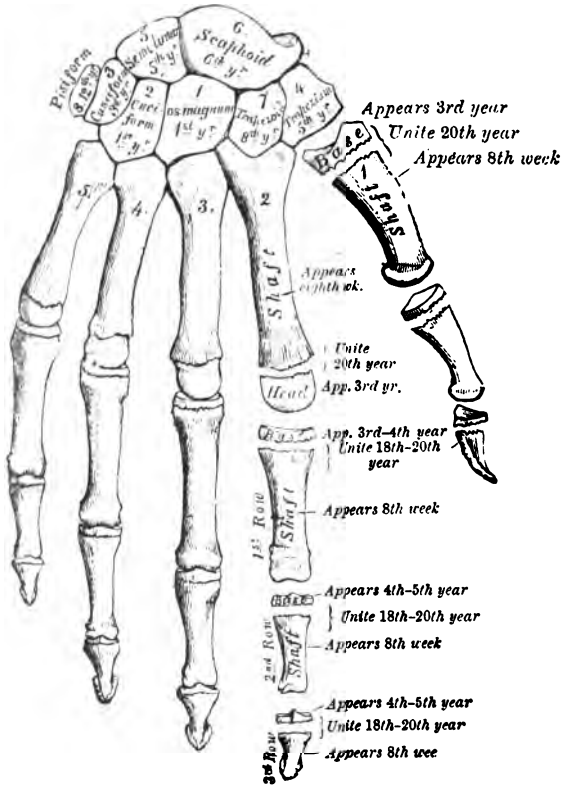
The first metacarpal & the first metatarsal have sometimes an additional epiphysis at their distal extremity (Allen Thomson).

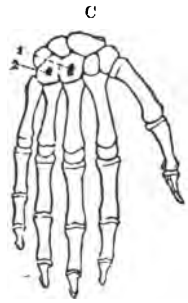
FIG. 159.—DEVELOPMENT OF THE CLAVICLE. (Quain.)

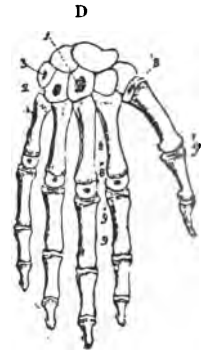
a, clavicle of a fœtus at birth; osseous in the shaft, and cartilaginous at both ends.

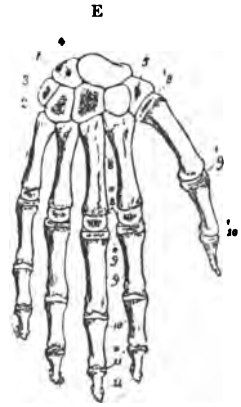
b, clavicle of a man about 23 years of age; the shaft (1) fully ossified at the acromial end; the sternal epiphysis (2) is represented rather thicker than natural.

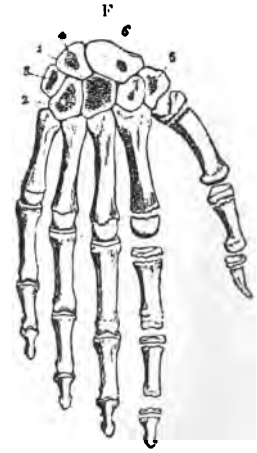
FIG. 160.—DEVELOPMENT OF THE BONES OF THE HAND. (A, Gray; B to F, Quain.)











B, the condition at birth. The carpus is entirely cartilaginous. Each of the metacarpal bones and digital phalanges has its shaft ossified.

C, at the end of the first year; the os magnum and unciform have begun to ossify.

D, about the third year. Centres of ossification are seen in the pyramidal and in the proximal epiphysis of the first and the distal epiphyses of the other four metacarpal bones, and in the proximal epiphyses of the first row of phalanges.

E, at the fifth year. Centres have been formed in the trapezium and later in the semilunar bone, and in the epiphyses of the middle and distal phalanges: (the figure does not show them distinctly in the middle phalanges).

F, at about the ninth year. Centres have been formed in the scaphoid and trapezoid bones, and the more developed epiphyses of the metacarpal bones and phalanges are shown in the first and second digits separately.

1, os magnum; 2, unciform; 3, pyramidal; 4, semilunar: 5, trapezium, 6, scaphoid; 7, trapezoid; 8, metacarpal bones, the principal pieces; 8*, four metacarpal epiphyses; 8′, that of the thumb; 9, first phalanges; 9*, their epiphyses; 9′, that of the thumb; 10, second phalanges; 10′, epiphysis of terminal phalanx of thumb; 11, terminal phalanges of the fingers; 11*, their epiphyses.

OSSIFICATION of the SHORT BONES.

Are all cartilaginous at birth, and are ossified as follows from one centre, except *Patella*, which has sometimes two centres placed side by side, and *Os Calcis*, which has an additional centre for its posterior & outer surfaces.

BONES of UPPER LIMB.

Os MAGNUM – 1st year.
UNCIFORM – 1st or 2nd year.
CUNEIFORM – 3rd year.
TRAPEZIUM, SEMILUNAR } – 5th year.
SCAPHOID – 6th or 7th year.
TRAPEZOID – 7th or 8th year.
PISIFORM – 12th year.

BONES of LOWER LIMB.

Os CALCIS – 6th month. The additional centre appears about 10th year, and joins with remainder of the bone about 15th or 16th year.
ASTRAGALUS – 7th month.
CUBOID – 9th month.
EXTERNAL CUNEIFORM – 1st year.
PATELLA – 3rd year. Has sometimes two centres placed side by side.
INTERNAL CUNEIFORM – 3rd year.
MIDDLE CUNEIFORM – 4th year.
SCAPHOID – 4th or 5th year.

FIG. 161.—DEVELOPMENT OF THE BONES OF THE FOOT. (Gray.)

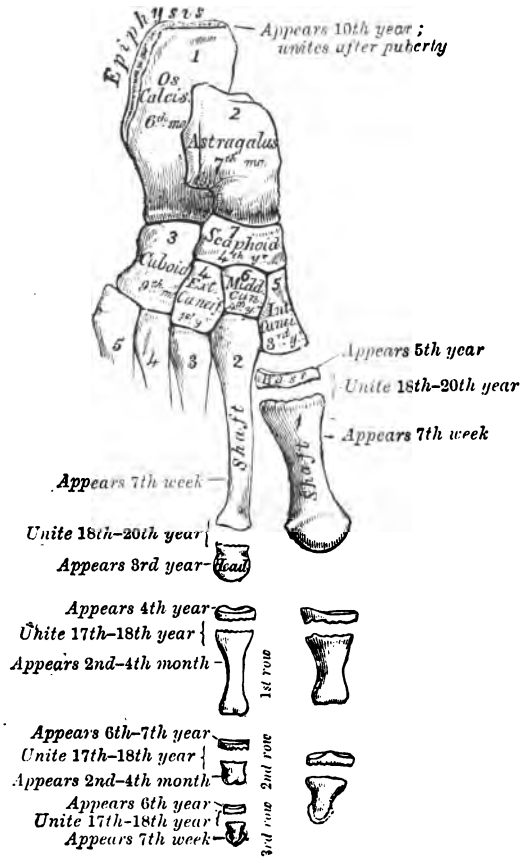
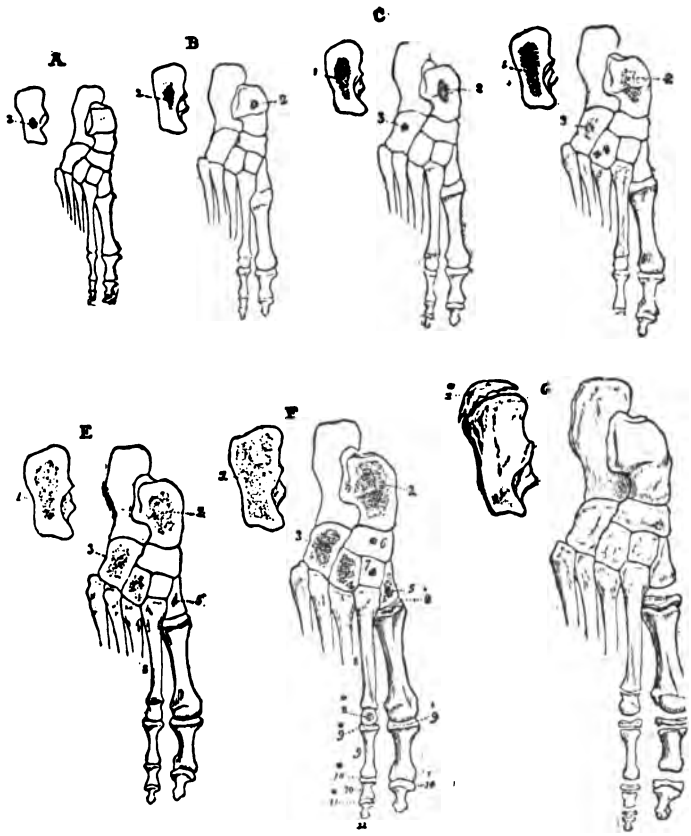


FIG. 162.—DEVELOPMENT OF THE BONES OF THE FOOT. (Quain.)



A, right foot of a fœtus of six months. The metatarsal bones and digital phalanges have each their shafts ossified from their primary centres; the tarsus is wholly cartilaginous, excepting the os calcis, in which the nucleus of bone has just appeared.

B, foot of a fœtus of from seven to eight months. The astragalus shows an osseous nucleus.

C, from a child at birth; the cuboid has begun to ossify.

D, from a child about a year old, showing a nucleus begun in the external cuneiform.

E, from a child in the third year; ossification has reached the internal cuneiform.

F, from a child between three and four years old, showing ossification in the middle cuneiform and scaphoid bones, and in the epiphyses of the metatarsal bones and phalanges.

G, from a person of about the age of puberty. Ossification is nearly complete in the tarsal bones; an epiphysis has been formed on the tuberosity of the os calcis, and the epiphyses of the metatarsal bones and phalanges are shown separate.

1, nucleus of the os calcis; 1* in G, the epiphysis of the os calcis; 2, nucleus of the astragalus; 3, of the cuboid; 4, of the external cuneiform; 5, of the internal cuneiform; 6, of the scaphoid; 7, of the middle cuneiform; 8, metatarsal bones; 8′, distal epiphyses of the four metatarsal bones; 8″, proximal epiphysis of the first; 9, first range of digital phalanges; 9′, proximal epiphyses of the four outer of these phalanges; 9′, that of the first phalanx of the great toe; 10, second range of phalanges; 10′, the epiphyses of these phalanges; 10′, epiphysis of the terminal phalanx of the great toe; 11, four terminal phalanges; 11*, their epiphyses.

LOWER JAW.

Is believed to be developed by several centres which unite very early, there being probably one principal centre appearing about the 5th week for each lateral half, and secondary centres appearing a little afterwards for the coronoid process, the condyle, the angle, and the inner side of the alveolar arch. But the bone is formed so early, – before any bone except the clavicle, – and so rapidly, that it is impossible to determine exactly its earliest condition. The greater part of the bone is formed in the fibrous tissue investing Meckel's cartilage, but the part near the symphysis is developed in the anterior extremity of this cartilage, while the condyle and a part of the ramus near the angle are developed from another mass of cartilage.

UPPER JAW.

Probably from five primary centres and two secondary ones. One of the primary centres, appearing about the 8th week, forms the premaxillary portion. Four others, appearing much about the same time, form in succession the facial portion, the back part of the alveolus, the orbital plate, and the palate process. These four latter parts speedily unite, when two secondary centres appear for the nasal and malar processes. The greater part of the bone is completed by the 10th week. The suture between the greater part of the bone and the intermaxillary portion persists till middle life, at least on the palatal aspect of the bone. The antrum appears about the 4th month of fœtal life; it is the first of the nasal sinuses to be formed.

MALAR BONE.

The upper & larger part of the bone is developed from a centre which appears near the orbital margin about the 7th week; the lower & smaller part is developed from a centre which appears a little later near the lower margin. These two parts usually join together about the 5th month, but are sometimes separate at birth, – a condition which recalls the permanent separation seen in some of the Quadrumana. A third centre is sometimes found in the posterior border.

PALATE BONE – One centre, at junction of horizontal and vertical plates, 7th or 8th week.

LACHRYMAL BONE – One centre, 8th week.

NASAL BONE – One centre, 8th week.

VOMER – One centre, near upper border, 8th week.

From this centre two lateral plates are developed from above downwards, one on either side of the median cartilage. These plates unite gradually into one; and by the age of puberty, the ossified septum presents a mere groove on its antero-superior border

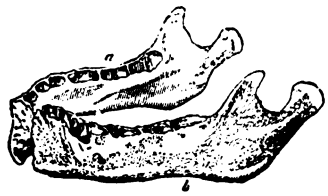
HYOID BONE.

Six centres: – Two for the body appearing about the 8th month, one for each greater cornu appearing a month later, and one for each lesser cornu appearing some months after birth. The cornua join with the body, the greater ones towards the middle of life, the lesser ones in advanced age.—The stylo-hyoid ligament is frequently ossified in part of its extent.

FRONTAL BONE.

Ossified from two centres in orbital arches, 7th or 8th week, from which ossification extends both upwards into the forehead and backwards into the orbit. The two halves of the bone are joined by a suture during the first year, and by osseous union from below upwards usually during the second. Four secondary centres sometimes make their appearance. There may be one for the nasal spine. There may be one for the internal angular process, where the latter articulates with the lachrymal bone. Lastly, there may be one at the lower end of the coronal suture on either side: this centre may join, not the fronal bone, but either of the three other bones – parietal, sphenoid, or temporal – which go to make up the pterion junction; or it may remain ununited, constituting what is called the *pterion ossicle.*

FIG. 163.—THE LOWER JAW OF A CHILD AT BIRTH. (Quain.)



a & *b* indicate the two portions separate at the symphysis.

FIG. 164.—THE VOMER AT BIRTH. (Quain.)

1 & 2, the two plates forming a groove for the reception of the septal cartilage.

FIG. 165.—DEVELOPMENT OF UPPER JAW. (1, Gray ; 2, Quain.)

1.

2.

FIG. 166.—DIFFERENT VIEWS OF THE SUPERIOR MAXILLARY BONE OF A FŒTUS OF FOUR OR FIVE MONTHS.

A, external surface ; a fissure, 1, is seen extending through the orbit into the infra-orbital foramen.

B, the internal surface ; the *incisor fissure*, 2, extends *from the foramen upwards through the horizontal plate and some way into the nasal process.*

C, the bone from below, showing the imperfect alveoli and the incisor fissure, 2′, 1, which crosses the palatine plate, between the second and third alveolus, and passes through the outer part of the bone.

OCCIPITAL BONE.

At birth this bone consists of four portions, – the expanded tabular portion, which is ossified in membrane, the basilar portion, and the two condylar portions, which are ossified in cartilage.

The *tabular* portion is usually ossified from four centres, which appear about the 8th week and soon unite to form a plate of bone fissured above, below, and on either side. The number of centres belonging to this portion varies, however, considerably: sometimes there is but one centre; sometimes there are as many as eight.

The *basilar* and the two *condylar* portions are each developed from a single centre appearing a few days later.

The tabular and condylar portions unite about the 4th year; the condylar and basilar portions, about the 6th year.

The occipital joins with the sphenoid between the 18th and 20th years.

PARIETAL BONE.

One centre in parietal eminence, 7th or 8th week; ossification gradually extends to the periphery of the bone. The parietal bone is formed in membrane.

ETHMOID BONE.

Three centres:—One for each *lateral mass*, in the os planum about 4th or 5th month, from which ossification extends into the turbinated processes. One for the *perpendicular & horizontal plates*, 1st year. The three parts of the bone unite about beginning of 2nd year. The ethmoid cells are formed about 4th or 5th year.

SPHENOID BONE.

Fourteen centres, – eight for the *post-sphenoid*, which includes the posterior part of the body, the great wings, and the pterygoid processes; – six for the *pre-sphenoid*, which includes the anterior part of the body, the lesser wings, and the sphenoidal turbinated bones.

Post-Sphenoid. – The eight centres, – four on each side, – are for:—

(1) *Greater wings & external pterygoid plates*, – between foramen ovale & foramen rotundum, – 8th week.

(2) *Posterior part of body*, – on either side of sella turcica, – a little later. These centres join together about the middle of fœtal life.

(3) *Linguæ*, – 4th month.

(4) *Internal pterygoid plates*, – 1 – 4th month. These plates are ossified in membrane, and become joined to the external pterygoid plates about the 6th month.

Pre-Sphenoid. – The six centres, – three on each side, – are for:—

(1) *Lesser wings*, – just external to the optic foramen, – 9th week.

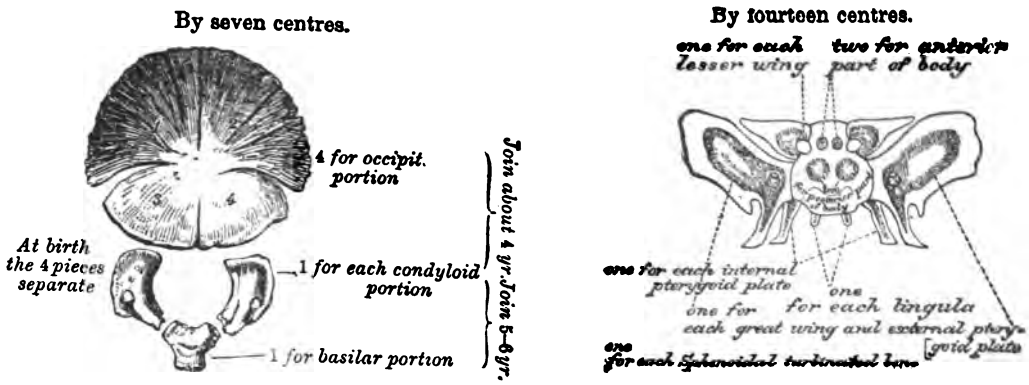
(2) *Front part of body*, – just internal to optic foramen, – a little later.

(3) *Sphenoidal turbinated bones*, – 5th month.

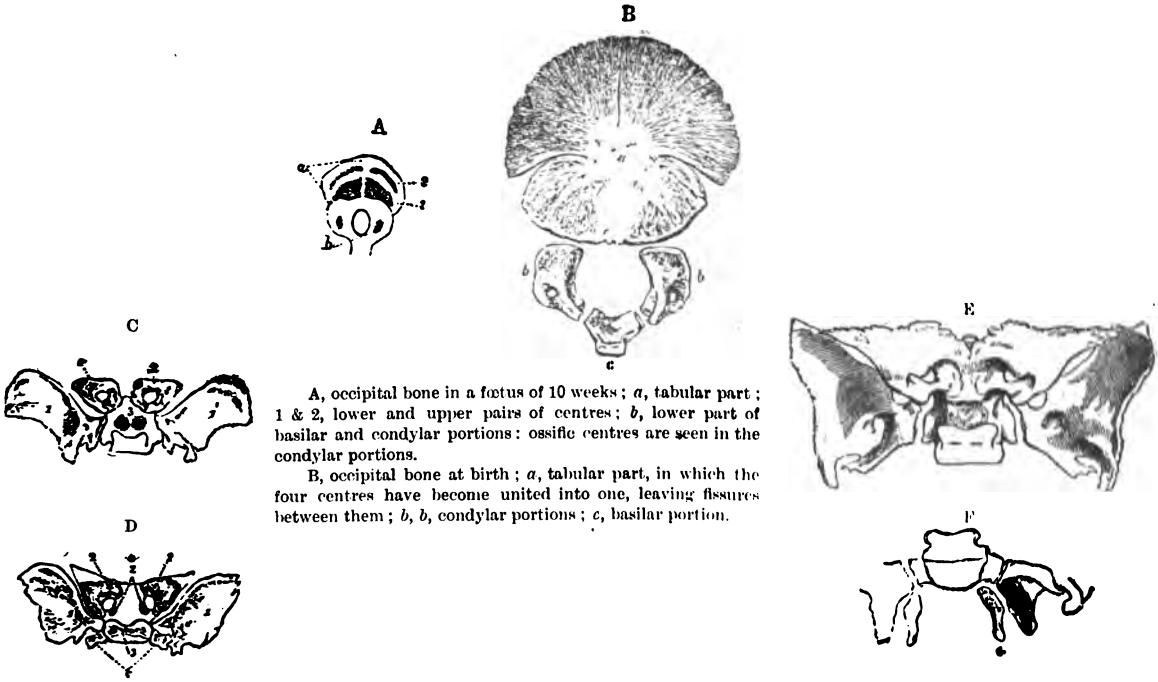
The lesser wings are joined to the front part of the body at birth. The pre-sphenoid, – consisting at this time of lesser wings & front part of body, – joins with the post-sphenoid about the 8th month, so that at birth the bone consists of three pieces, – the body with the lesser wings in the centre, and the greater wings & pterygoid processes on either side. The greater wings & pterygoid processes are joined to the body during the first year after birth. It is not before the 10th or 12th year that the sphenoidal turbinated bones begin to join the body of the pre-sphenoid, the union remaining incomplete till about the 20th year. The post-sphenoid joins with the occipital between the 18th and 20th years.

FIG. 167.—DEVELOPMENT OF THE OCCIPITAL AND SPHENOID BONES. (1, Gray; 2, Quain.)

1.


By seven centres.
4 for occipit. portion
Join about 4 yr.
At birth the 4 pieces separate
1 for each condyloid portion
Join 5–8 yr.
1 for basilar portion
By fourteen centres.
one for each lesser wing
two for anterior part of body
one for each internal pterygoid plate
one for each great wing
one for each lingula
and external pterygoid plate
one for each spheno-ethmoidal turbinated bone

2.



A, occipital bone in a fœtus of 10 weeks; *a*, tabular part; 1 & 2, lower and upper pairs of centres; *b*, lower part of basilar and condylar portions: ossific centres are seen in the condylar portions.

B, occipital bone at birth; *a*, tabular part, in which the four centres have become united into one, leaving fissures between them; *b*, *b*, condylar portions; *c*, basilar portion.

C, sphenoid bone at an early period, seen from above; 1, 1′, the greater wings ossified; 2, 2′, the lesser wings, in which the ossification has encircled the optic foramen, and a small suture is distinguishable at its posterior and inner side; 3, two round granules of bones in the body below the sella turcica, the rest being cartilaginous.

D, copied from Meckel (Archiv., vol. i., tab. vi., fig. 23), and stated to be from a fœtus of six months; 2, additional nuclei for the lesser wings; 5, separate lateral processes of the body (lingula). The other indications are the same as in A.

E, back part of the bone shown in A; 4, internal pterygoid plates still separate.

F, sphenoid at birth. The great wings are still separate. The presphenoid is now joined to the basisphenoid, and the internal pterygoid plates (not seen in the figure) are united to the external.

TEMPORAL.

Ten centres, exclusive of those for the internal ear, as follows:—

Squamo-Zygomatic Portion, – One.
Tympanic Portion, – One.
Petro-Mastoid Portion, – Six.
Styloid Process, – Two.

The centre for the *squamo-zygomatic portion*, which is ossified in membrane, appears in the lower part of the same about the 7th or 8th week.

The centre for the *tympanic portion* appears in the lower part of the same about the 3rd month; the tympanic portion is an imperfect ring deficient in its upper fourth, and grooved on its inner surface for the attachment of the membrani tympani.

The six centres for the *petro-mastoid portion* appear about the 5th or 6th month: two belong to the mastoid portion; four belong to the petrous portion, and surround the labyrinth (see below).

The two centres for the *styloid process* are one for the base (tympano-hyal portion of the process), which appears before birth, – and one for the rest of the process (stylo-hyal portion), which appears after birth.

The tympanic portion joins with the squamo-zygomatic before birth. The squamo-zygomatic and petro-mastoid portions join together about the end of the 1st year, though not completely, a portion of the cleft between them remaining as the Glaserian fissure. About the same time the tympano-hyal portion of the styloid process is joined to the petrous bone The rest of the process joins with the remainder of the bone at puberty only, or not at all.

The mastoid process, first quite flat, begins to protrude about the second year; but its cells are not formed till puberty.

NOTES ON THE NEWER POINTS.

Of the labyrinthic centres, the first to appear is a nucleus on the promontory (opisthotic), which spreads round the fenestra rotunda, and forms the portion of the petrous bone below the internal auditory meatus and fenestra ovalis. The second (prootic) appears over the superior semicircular canal, and forms most of the petrous bone seen in the interior of the skull, as well as the upper and inner part of the mastoid portion; it forms the upper boundaries of the internal auditory meatus and fenestra ovalis. A little later a third nucleus (epiotic), which is occasionally double, is developed in connection with the posterior semicircular canal, and extends into the lower part of the mastoid portion (Huxley). According to Sutton, the tegmen tympani and covering of the external semicircular canal are formed by a separate ossification (pterotic), appearing about the same time as the prootic. According to Huxley, there would also be a separate centre in connection with the common crus of the superior and posterior semicircular canals; and according to Vrolik there would be another for the roof of the cochlea (Quain).

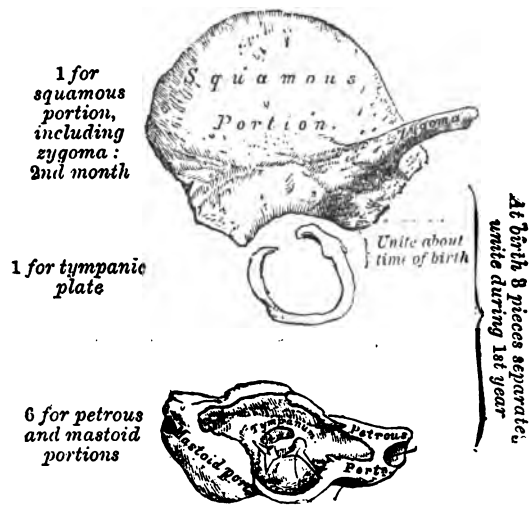
What can the medical practitioner, as such, have to do with the details of labyrinthic centres, opisthotic, prootic, epiotic, pterotic, with the pterion ossicle, and so forth? Is it not plain that we are on the wrong track, educationally, when such details find their way into text-books for students, and are thus presented as subjects of examination? It is mere "crammed" knowledge, – sham knowledge masking real ignorance, – that must result from such conditions.

And is there, or not, another centre to be added henceforth for such important structures as the vertebral bodies? – and is there yet another to be added for the spinous

FIG. 168.—FRONTAL BONE OF A FŒTUS SHORTLY BEFORE BIRTH. (Quain.)

a & *b* indicate the two portions of the bone, in each of which the radiation of bony spicula from the frontal eminence is seen.

By ten centres.


1 for squamous portion, including zygoma: 2nd month
Squamous Portion
Zygoma
Unite about time of birth
1 for tympanic plate
At birth 3 pieces separate, unite during 1st year
6 for petrous and mastoid portions
Petrous Portion
Mastoid Portion
2 for styloid process

processes? Correlated with the view of a second centre for the vertebral bodies generally, is there an additional centre for the body of the axis? And are there additional centres for the bodies of the five sacral vertebræ? Of two well-known authorities, one gives one view, and the other the other.

The point may be put somewhat as follows:—

Hinauf and Hinab are editors of German text-books, not uninterested, some say, in recording friendly labours directed, those recorded by Hinauf at over-capping or contradicting those recorded by Hinab, and those recorded by Hinab at over-capping or contradicting those recorded by Hinauf – this in regard to the "zone of strife," where, writes an eminent Professor, "Truth and Error mingle in conflict, and the results of yesterday have power because they are new."

— Says Hinauf: Vertebræ, three primary centres.

— Says Hinab, *Four*. And herewith Hinab proceeds to show, – on paper, – for the vertebral bodies, "two centres, which sometimes unite."

— Says Hinauf: Vertebræ, five secondary centres.

— Says Hinab, *Six*. And herewith Hinab proceeds to describe for the spinous processes "two centres, or . . . . sometimes one."*

What are the authorities of Hinauf and Hinab?

The author confesses that he does not set much store by the details of Bone development, except as regards just a few practical points; and that he thinks it a pity that students should be expected (but are they expected?) to "get them all up," merely to forget them again.

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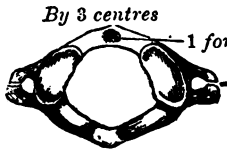
* The two views are given, one in the text, the other in the figures. It may be explained that Hinauf is the German for *up there;* Hinab the German for *down there.* The supposed names are compounds of the German *auf* and *in* (*up* and *down*), with the preposition *hin* indicative of direction

FIG. 170.—DEVELOPMENT OF THE PECULIAR VERTEBRÆ. 1, Gray; 2, Quain.)

1.

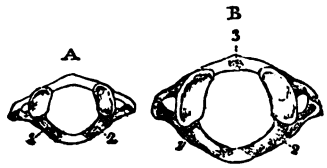
ATLAS.



AXIS.

2.

ATLAS.



A, before birth; 1 & 2, lateral centres of ossification; the anterior arch is cartilaginous.

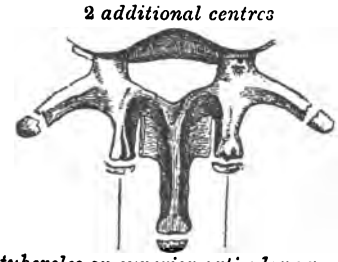
B, in the first year; 1 & 2, as before; 3, ossific centre in the anterior arch.

AXIS.

A, from a fœtus of seven months; 3, the centre for the body; 4 & 5, two centres for the base of the odontoid process.

B, shortly after birth; 1 & 2 the lateral centres 3, centre for the body; 6, the two centres for the odontoid process now united.

FIG. 171.—A LUMBAR VERTEBRA. (Gray.)



OSSIFICATION of the SPINE—2nd Tablet.

ATLAS.

Two Lateral Primary Centres - Near articular processes, 7th week; for lateral masses & posterior arch. - These centres correspond to the lateral centres of the other vertebræ.

The two halves of the posterior arch unite during 3rd year, their union being frequently preceded by the appearance of a *median spinal centre.*

The Atlas having no body, has *no central primary centre;* the anterior arch remains therefore as a simple band of cartilage for a considerable time. It is ossified sometimes by extension of osseous tissue from the lateral masses, at other times from either *one central or two lateral secondary centres* appearing in 1st year. When ossified separately, the anterior arch joins with the lateral masses in 5th or 6th year.

AXIS.

Three Centres for Body - Two lateral and one median;* the two former appearing in 7th or 8th week for *laminæ & processes;* the latter appearing in 6th month for *lower part of body.*

Three Centres for Odontoid Process - Two lateral, & one median.

The former for *lower part* of the process, 6th month. - These centres unite before birth into a bi-lobed conical mass deeply cleft above, which joins with body during 3rd year.

The latter, for *apex*, appears in the 2nd year in the wedge-shaped piece of cartilage which fills up the cleft, and joins the remainder of the process about the 12th year.

SEVENTH CERVICAL VERTEBRA - *Anterior part of transverse process* is developed from a *separate centre* which appears about 6th month; it joins posterior part and body between 5th & 6th years. Sometimes this portion of the bone remains separate, and, extending outwards, developes into a *cervical rib.*

The anterior part of the other cervical transverse processes is usually ossified by extension of osseous tissue from lateral primary centres. Additional centres, but appearing much later, have however been observed in the sixth & even the fifth vertebræ (Meckel).

LUMBAR VERTEBRÆ - *Two additional centres* for *tubercles on back of superior articular processes* (*mammillary tubercles*).

The transverse process of the first lumbar vertebra is sometimes developed from a separate centre, and may then remain permanently unconnected with the rest of the bone, forming a *lumbar rib.*

* Or two median, which speedily unite (see pp. 154 & 155).

OSSIFICATION of the SPINE—3rd Tablet.

THE SACRUM – Thirty-five centres, which may be grouped as follows: –

Fifteen Primary Centres – Namely, *three for each of the five vertebræ*, as follows:

ONE FOR BODY – 8th or 9th week in the three upper vertebræ, rather later in the two lower ones.*

TWO FOR LAMINÆ, SPINOUS, POSTERIOR TRANSVERSE, & ARTICULAR PROCESSES, AND SMALL PORTION OF BODY – 6th month

Twenty Secondary Centres – Which may be grouped as follows: –

FOR ANTERIOR TRANSVERSE PROCESSES OF THE THREE UPPER VERTEBRÆ – Three on each side, above & externally to anterior sacral foramina, 7th month.

FOR UPPER & UNDER SURFACES OF BODIES – Two for each vertebra, 16th year.

FOR AURICULAR SURFACES & BORDERS – Two on each side, 18th or 20th year.

The *bodies* are at first separated by *intervertebral discs*. These begin to ossify from below upwards about 18th year. The bodies of the two first vertebræ, however, are not united before 25th year, or later.

The *laminæ & processes* are joined to the bodies, and the several *lateral masses* to each other, also from below upwards, union taking place about 2nd year in the lower vertebræ, about 5th or 6th year in the upper ones.

The two *lateral plates* join with remainder of the bone about 25th year.

Sometimes there are separate centres for the anterior transverse processes of the two upper vertebræ only, the total number of centres being then reduced to thirty-three.

THE COCCYX – The four coccygeal vertebræ are usually developed each of them from one centre, the first one sometimes from two; ossification commencing in the

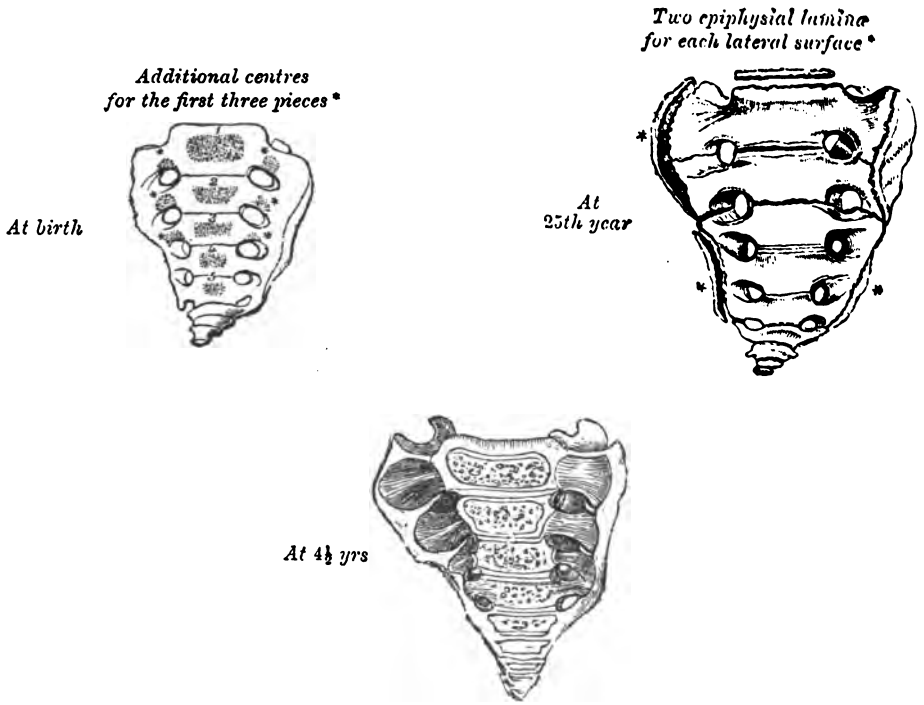
1st vertebra	- -	about the time of birth;
2nd „	- -	from 5th to 10th year;
3rd „	- -	a little before puberty;
4th „	- -	a little after puberty.

The three lower vertebræ join together before the middle of life; the second one joins with the first at a later period; and ultimately, especially in the male, the first vertebra may join with the sacrum.

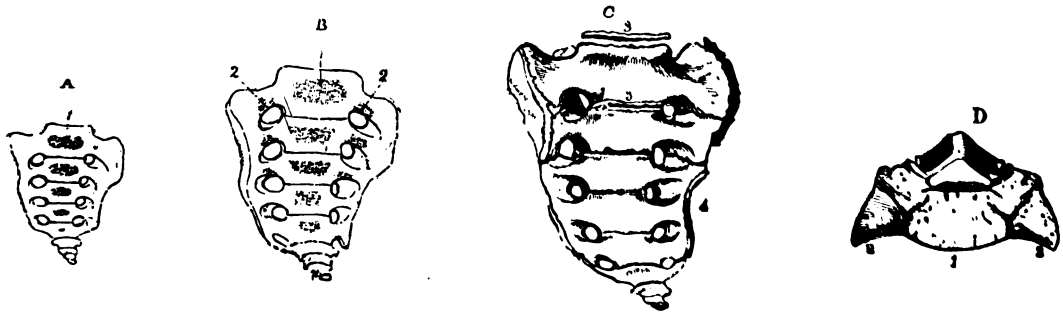
* Sometimes two in the upper two sacral vertebræ.

FIG. 172.—DEVELOPMENT OF THE SACRUM. (1, Gray; 2, Quain.)

1.



2.



A, sacrum of a fœtus before six months, seen from the front, showing the ossific nucleus in the body of each vertebra, from 1 downwards.

B, sacrum of a child at birth, showing three pairs of additional nuclei for the lateral masses, 2, 2, close above the sacral foramina.

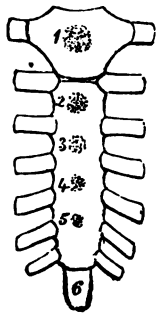
C (one-fourth of the size of nature), sacrum of a person of about twenty-five years of age. At 3 & 3, epiphyseal plates are still visible above and below the first vertebral piece, and the fissures still remain between the first and second and the second and third lateral pieces; at 4 & 4' are shown the lateral epiphyseal plates.

D, upper surface of first sacral vertebra at four or five years; 1 and 2, as in A and B.

A & B, nearly full size; C, one-fourth; D, one-third.

FIG. 173.—DEVELOPMENT OF THE SACRUM. (1, Gray ; 2, Quain)

1

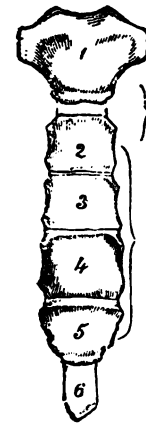


Time of appearance

1 *for* 1*st piece or manubrium* } 5–6*th month fœtal*

4 *for* 2*nd piece or gladiolus*
- 2, 3 — 6–7*th month*
- 4 — 9*th month*
- 5 — 1*st year after birth*

1 *for ensiform cartilage* } 2*nd to* 18*th year*



Time of union

Rarely unite, except in old age

Between puberty and the 25*th year*

Soon after puberty

Partly cartilaginous to advanced life

Peculiarities :

(*a*)

In number of centres

for first piece, two or more centres

for second piece, usually one

for third

for fourth } 2, *placed laterally*

for fifth

And in mode of union

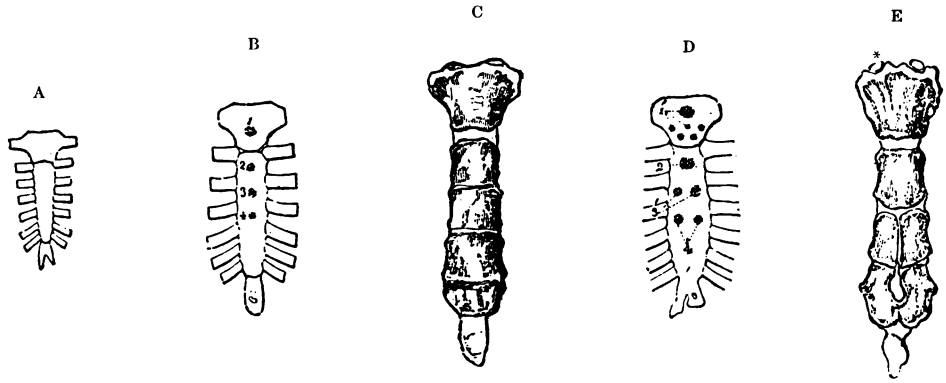
(*b*)

Arrest of development of lateral pieces, producing

Sternal fissure, and

Sternal foramen

2.



A, the cartilaginous sternum before the middle of fœtal life.

B, the sternum of a child at birth. 1, 2, 3, & 4, mark the commencing ossific nuclei for the manubrium and three upper pieces of the body.

C, the sternum soon after puberty, showing cartilage between the manubrium and body, and imperfect union of the first, second, and third pieces of the body, while the third and fourth are united.

D, shows an example of a sternum at birth with an unusual number of ossific centres, six in the manubrium, 1′, which is very uncommon ; two pairs in the lower pieces of the body, 3′ & 4′, which is not unusual ; 2, the single centre of the first piece of the body.

E, exhibits an example of the perforated sternum which propably depends upon the imperfect union of the pairs of ossific nuclei shown in D in the lower part of the body ; this figure also shows two episternal bones or granules, * *

OSSIFICATION of the BONES of the THORAX.

STERNUM.

NORMAL CENTRES – Six. – One in centre of each primitive segment : –

Manubrium – One, 5th or 6th month.

Gladiolus – Four, as follows : –

First & Second Segments – One each, 6th or 7th month.
Third Segment – One, 9th month.
Fourth Segment – One, 1st or 2nd year after birth.

Ensiform Appendix - One, between 2nd and 18th years.

ADDITIONAL CENTRES - Are not unfrequently met with. Thus the

Manubrium - May have

Two centres one above the other, of which the upper one is the larger; or *three*, or sometimes *six*. – It frequently presents *Two small Episternal Centres*, one on each side of interclavicular notch.

Second, Third, & Fourth Segments of Gladiolus - May have

Two Lateral Centres Each – The occasionally imperfect union of which centres may give rise to a *sternal foramen*.

The *ensiform appendix & the first segment of the gladiolus* have rarely more than one centre each.

UNION - Takes place between the above pieces as follows :–

Gladiolus – (From below upwards) :

Third & Fourth Segments – Soon after puberty.
Second & Third Segments – Between 20th and 25th years.
First & Second Segments – A little later.

Gladiolus & Ensiform Appendix – Middle period of life.
Manubrium & Gladiolus - In very advanced age.

RIBS - Three centres each, except in case of two last.

Shaft – One, in posterior part, 7th or 8th week. – Ossification extends rapidly, and reaches situation of permanent (costal) cartilage about 4th month.

Head
Tubercle } - One each, 16th to 20th year ; join with shaft about 25th year.

The *two last ribs*, having no tubercles, are ossified, each from two centres only.

TABLEAU of the OSSIFICATION of the LONG BONES.

SHAFT — One centre, from a little before middle to a little after end of 2nd month: -

CLAVICLE & FEMUR, first - 5th & 6th week.
METACARPAL, METATARSAL BONES, & PHALANGES, last - 8th or 9th week.
At birth, all the shafts are ossified in the greater part of their extent.

EPIPHYSES — One centre for each, except: -

FEMUR - Two additional centres for *trochanters*.
HUMERUS Four additional centres for *greater tuberosity, condyles, & inner portion of trochlea.*

The metacarpal & metatarsal bones (except the first) have their epiphysis at their *distal* or phalangeal extremity; the first metacarpal & first metatarsal bones and the phalanges have their epiphysis at their *proximal* extremity; the clavicle has its epiphysis at its *sternal* extremity.

Dates of Appearance of the Epiphyses.

AT BIRTH - Lower ep. of femur;
Upper ep. of tibia.
1ST YEAR - Upper ep. (head) of femur;
Upper ep. (head) of humerus (1st or 2nd year).
2ND YEAR - Lower eps. of tibia, fibula, & radius (Radius, 2nd or 3rd year),
Capitellum & outer portion of trochlea of humerus (2nd or 3rd
3RD YEAR - Greater tuberosity of humerus; [year).
4TH YEAR - Upper ep. of fibula;
Greater trochanter of femur;
Lower ep. of ulna (4th or 5th year).
5TH YEAR - Upper ep. of radius;
Lesser tuberosity & inner condyle of humerus.
10TH YEAR - Upper ep. of ulna (tip of olecranon).
11TH OR 12TH Y. - Inner portion of trochlea of humerus.
13TH OR 14TH Y. - Lesser trochanter of femur;
Outer condyle of humerus.
18TH OR 20TH Y. - Sternal end of clavicle.
3RD TO 8TH Y. - Eps. of the metacarpal & metatarsal bones, & phalanges.

Dates of their Union with the Shaft.

16TH YEAR - Upper ep. of ulna.
16TH OR 17TH Y. - Outer condyle, & the two portions of inferior articular surface of [humerus (16th or 17th year).
17TH YEAR - Lesser trochanter of femur.
17TH OR 18TH Y. - Upper ep. of radius;
18TH YEAR - Inner condyle of humerus.
Greater trochanter of femur.
18TH TO 21ST Y. - Eps. of metacarpal, and metatarsal bones, & phalanges, and [lower ep. of tibia.
19TH YEAR - Head of femur.
20TH YEAR - Lower eps. of femur, radius, ulna, & fibula, and upper ep. of [tibia.
21ST YEAR - Upper ep. of humerus.
25TH YEAR - Upper ep. of fibula, & sternal end of clavicle.

In the upper limb, the epiphyses which enter into the formation of the elbow-joint, and *towards* which the respective nutrient foramina are directed, ossify later than the opposite epiphyses, but they unite earlier with the shaft. In the lower limb, the epiphyses which enter into the formation of the knee-joint, and *from* which the respective nutrient foramina are directed, ossify (except in the case of the upper epiphysis of the fibula) earlier than the opposite epiphyses, but they unite later with the shaft.

THE MUSCLES ATTACHED TO THE BONES OF THE LIMBS.

MUSCLES ATTACHED to BONES of UPPER LIMB—1st T.

The muscles attached to the

CLAVICLE — Are six in number, and are attached as follows: -

Sterno-Cleido-Mastoid – Anterior surface & upper border of inner third.
Pectoralis Major – Anterior surface & anterior border of inner half.
Deltoid – Upper surface & anterior border of outer half.
Trapezius – Upper surface & posterior border of outer third.
Subclavius – Groove on under surface of middle third.
Sterno-Cleido-Hyoid – Sometimes, from back of inner extremity.

SCAPULA — Seventeen in number, and are attached as follows: -

Supraspinatus – Inner two-thirds of supraspinous fossa.
Infraspinatus – Inner two-thirds of infraspinous fossa & ridges on its surface.
Teres Major – Posterior aspect of inferior angle.
Teres Minor – Upper two-thirds of posterior aspect of axillary border.
Deltoid – Upper surface & outer border of acromion, whole length of lower lip of posterior border of spine.
Trapezius – Upper surface and inner border of acromion, whole length of upper lip of posterior border of spine.
Subscapularis – Inner two-thirds of subscapular fossa & ridges on its surface.
Serratus Magnus – Whole length of anterior lip of posterior border.
Rhomboideus Major – Posterior border between spine & inferior angle.
Rhomboideus Minor – Posterior border opposite triangular smooth surface at root of spine.
Levator Anguli Scapulæ – Posterior border between spine & superior angle.
Omo-Hyoid – Upper border on inner side of suprascapular notch.
Long Head of Triceps – Rough triangular depression below glenoid cavity.
Pectoralis Minor – Inner border of coracoid process.
Coraco-Brachialis, *Short Head of Biceps* – Tip of coracoid process.
Long Head of Biceps – Top of glenoid cavity.
Latissimus Dorsi – Sometimes, from back of inferior angle.

MUSCLES ATTACHED to BONES of UPPER LIMB—2nd T.

The muscles attached to the

HUMERUS — Are twenty-four in number, and are attached as follows: –

Supraspinatus – Highest of the three facets on greater tuberosity.
Infraspinatus – Middle facet on greater tuberosity.
Teres Minor – Lowest facet on greater tuberosity, and by a few fleshy fibres into the neck for a short distance lower down.
Subscapularis – Lesser tuberosity, and by a few fleshy fibres into the neck for a short distance lower down.
Teres Major – Inner or posterior edge of bicipital groove.
Pectoralis Major – Anterior or outer edge of bicipital groove.
Latissimus Dorsi – Bottom of bicipital groove.
Deltoid – Rough triangular prominence a little above middle of outer surface of shaft.
Coraco-Brachialis – Rough impression a little above middle of inner surface of shaft.
Brachialis Anticus – Lower half of inner & outer surfaces of shaft.
Inner & Outer Heads of Triceps –
Inner head – Posterior surface of shaft below musculo-spiral groove, inner border.
Outer head – Posterior surface of shaft above musculo-spiral groove, outer border.
Supinator Longus – Upper two-thirds of external condyloid ridge.
Extensor Carpi Radialis Longior – Lower third of external condyloid ridge.
Extensor Carpi Radialis Brevior – External condyle.
Extensor Communis Digitorum – „
Extensor Minimi Digiti – „
Extensor Carpi Ulnaris – „
Anconeus – „
Supinator Brevis – „
Pronator Radii Teres (Inner Head) – Inner condyle & internal condyloid ridge immediately above it.
Flexor Carpi Radialis – Inner condyle.
Palmaris Longus – „
Flexor Carpi Ulnaris (Anterior or Outer Head) – Inner condyle.
Flexor Sublimis Digitorum (Middle Head) – „

MUSCULAR ATTACHTS. of BS. OF UPPER LIMB—3rd T.

The muscles attached to the

RADIUS — Are nine in number, and are attached as follows: –

Biceps – Back part of bicipital tuberosity.
Supinator Brevis – Inner, anterior & outer aspects of the bone above bicipital tuberosity & oblique line as low down as insertion of pronator radii teres.
Flexor Sublimis Digitorum (Outer Head) – Oblique line.
Pronator Radii Teres – Rough impression on middle of outer surface of shaft.
Flexor Longus Pollicis – Upper two-thirds of anterior surface of shaft.
Pronator Quadratus – Lower fourth of anterior surface & outer border.
Extensor Ossis Metacarpi Pollicis – Middle third of posterior surface of shaft.
Extensor Primi Internodii Pollicis – Posterior surface of shaft below foregoing.
Supinator Longus – Outer side of base of styloid process.

ULNA — Are thirteen in number, and are attached as follows: –

Supinator Brevis – Triangular depression below lesser sigmoid cavity & ridge behind the depression.
Brachialis Anticus – Under surface of coronoid process.
Flexor Sublimis Digitorum (Middle Head) – Tubercle on inner surface of coronoid process above pronator radii teres.
Pronator Radii Teres (Outer Head) – Ridge on inner surface of coronoid process below flexor sublimis.
Flexor Profundus Digitorum – Depression on inner surface of coronoid process, upper two-thirds of anterior & inner surfaces, and, by an aponeurosis which is common to it & to flexor carpi ulnaris, upper two-thirds of posterior border.
Flexor Carpi Ulnaris (Posterior Head) – Inner border of olecranon, and by an aponeurosis which is common to it & to flexor profundus, upper two-thirds of posterior border.
Triceps – Back part of upper surface of olecranon.
Anconeus – Rough triangular surface on outer side of olecranon & upper third of shaft.
Pronator Quadratus – Lower fourth of anterior surface & inner border.
Extensor Carpi Ulnaris – Middle third of posterior border. Usually it simply covers, but sometimes it arises from, narrow portion of posterior surface internal to the vertical ridge.
Extensor Ossis Metacarpi Pollicis – Outer half of posterior surface below insertion of anconeus.
Extensor Secundi Internodii Pollicis – Middle of outer half of posterior surface.
Extensor Indicis – Posterior surface below foregoing.

MUSCLES ATTACHED to BONES of LOWER LIMB—1st T.

The muscles attached to the

INNOMINATE BONE — Are thirty-two in number, and are attached as follows: –

Ilium – Thirteen: –

Gluteus Maximus – Superior curved line on dorsum ilii and rough surface between it & posterior fifth of crest.
Gluteus Medius – Dorsum ilii & outer lip of crest between superior & middle curved lines.
Gluteus Minimus – Dorsum ilii between middle & inferior curved lines.
Rectus Femoris (Reflected Tendon) – Groove above brim of acetabulum.
(Straight Tendon) – Anterior inferior spine.
Iliacus – Iliac fossa & inner lip of crest.
Sartorius – Anterior superior spine & upper half of notch below it.
Tensor Vaginæ Femoris – Anterior superior spine & anterior fifth of outer lip of crest.
Obliquus Externus – Anterior half of outer lip of crest.
Latissimus Dorsi – Posterior half of outer lip of crest.
Internal Oblique – Anterior two-thirds of middle lip of crest.
Transversalis – Anterior three-fourths of inner lip of crest.
Quadratus Lumborum – Posterior part of inner lip of crest for about two or three inches in front of erector spinæ.
Erector Spinæ – Posterior superior spine & posterior fifth of inner lip of crest.

Ischium – Fourteen: –

Gracilis – Inner margin of ascending ramus.
Adductor Magnus – Ascending ramus & outer side of tuberosity.
Obturator Externus – Circumference of obturator foramen.
Transversus Perinæi – Inner & fore part of tuberosity.
Erector Penis or Clitoridis – Pubic arch & fore part of inner side of tuberosity.
Obturator Internus – Whole of inner surface of true pelvis in front of and behind obturator foramen.
Gemellus Superior, *Levator Ani*, *Coccygeus* – Spine.
Gemellus Inferior – Upper part of outer lip of tuberosity.
Quadratus Femoris – Whole length of outer lip of tuberosity.
Biceps (Long Head) – Lower & inner of the two surfaces on back part of tuberosity.
Semitendinosus – Lower & inner of the two surfaces on back part of tuberosity.
Semimembranosus – Upper & outer of the two surfaces on back part of tuberosity.

Pubes – Twelve: –

Pectineus – Ilio-pectineal line & surface in front of it.
Adductor Longus – Front of body immediately below the crest & close to angle.
Adductor Brevis – Front of body for about two inches below adductor longus & between gracilis & obturator externus.
Adductor Magnus – Lower part of descending ramus.
Gracilis – Inner margin of ramus & lower half of inner margin of body.
Obturator Externus – Circumference of obturator foramen.
Obturator Internus – Whole of inner surface of true pelvis in front of & behind obturator foramen.
Rectus abdominis, *Pyramidalis*, *Conjoined Tend. of Int. Oblique & Transv.* – Crest.
Levator Ani – Back of body.

MUSCLES ATTACHED to BONES of LOWER LIMB—2nd T.

The muscles attached to the

FEMUR — Are twenty-four in number, and are attached as follows: –

Vastus Externus – Anterior border of great trochanter & horizontal ridge on its outer surface; rough line from great trochanter to linea aspera; whole length of outer lip of linea aspera and line from linea aspera to outer condyle.

Vastus Internus – Line from inner side of neck of femur to linea aspera; whole length of inner lip of linea aspera & line from linea aspera to inner condyle; inner surface.

Crureus – Anterior & outer surfaces from anterior intertrochanteric line to within a few inches of condyles.

Taking the vastus internus & the crureus as forming but one muscle, and describing the *Quadriceps extensor femoris* as a *Triceps*, we may say that the "VASTUS INTERNUS" arises from: – line from inner side of neck of femur to linea aspera; whole length of inner lip of linea aspera & line from linea aspera to inner condyle; nearly whole of *inner, anterior* and *outer* surfaces of shaft of femur.

Subcrureus – Lower part of anterior surface of femur.

Psoas Magnus – Lesser trochanter.

Iliacus – Upper part of line from trochanter minor to linea aspera in front of pectineus.

Pectineus – Upper part of line from trochanter minor to linea aspera, & into the bone behind trochanter minor.

Adductor Longus – Middle third of inner lip of linea aspera between vastus internus & adductor magnus.

Adductor Brevis – Upper part of linea aspera & lower part of line from it to lesser trochanter below & behind pectineus.

Adductor Magnus – Lower part of line from great trochanter to linea aspera, whole length of inner lip of linea aspera & line from it to inner condyle; by a strong tendon into tubercle at upper & back of inner condyle.

Biceps (Short Head) – Whole length of outer lip of linea aspera between adductor magnus & vastus externus, and from inferior external division of linea aspera to within two inches of outer condyle.

Gluteus Maximus – Rough line from great trochanter to linea aspera.

Gluteus Medius – Oblique line on outer surface of great trochanter.

Gluteus Minimus – Anterior border of great trochanter.

Pyriformis – Posterior part of upper border of great trochanter.

Obturator Internus – Upper border of great trochanter in front of pyriformis.

Gemellus Superior. } Indirectly, by joining tendon of foregoing.
Gemellus Inferior. }

Quadratus Femoris – Upper part of linea quadrati on back of great trochanter.

Obturator Externus – Digital fossa.

Gastrocnemius – Depressions at upper and back part of condyles, and lower part of the two inferior divisions of linea aspera.

Plantaris – Lower part of outer division of linea aspera.

Popliteus – Anterior & deepest part of groove on outer side of outer condyle of femur below tubercle for external lateral ligament of knee-joint.

Semimembranosus – Posterior & upper part of inner condyle.

MUSCULAR ATTACHTS. of BS. of LOWER LIMB—3rd T.

The muscles attached to the

TIBIA — Are ten in number, and are attached as follows: -

Tibialis Anticus - Outer tuberosity & upper two-thirds of outer surface of shaft.
Extensor Longus Digitorum - Outer tuberosity.
Sartorius - Upper part of inner surface of shaft covering tendons of gracilis & semitendinosus.
Gracilis - Upper part of inner surface of shaft above semitendinosus, and beneath sartorius.
Semitendinosus - Upper part of inner surface of shaft below gracilis & beneath sartorius.
Semimembranosus - Posterior part of inner tuberosity; groove on inner side of inner tuberosity.
Poplitcus - Inner two-thirds of triangular surface on back of upper part of shaft.
Soleus - Middle third of inner border, and oblique line on posterior surface of shaft.
Flexor Longus Digitorum - Posterior surface of shaft below oblique line & internally to attachment of tibialis posticus.
Tibialis Posticus - Posterior surface of shaft below oblique line & externally to attachment of flexor longus digitorum.

FIBULA — Are nine in number, and are attached as follows: -

Extensor Longus Digitorum - Upper three-fourths of anterior surface of shaft.
Extensor Proprius Pollicis - Middle two-fourths of anterior surface of shaft internally to extensor longus digitorum.
Peroneus Tertius - Lower fourth of anterior surface of shaft.
Peroneus Longus - Head & upper two-thirds of outer surface & of anterior & posterior borders.
Peroneus Brevis - Lower two-thirds of outer surface of shaft, passing upwards in a pointed process beneath peroneus longus.
Biceps - Outer side of head.
Soleus - Back of head & upper third of posterior surface of shaft.
Flexor Longus Pollicis - Lower two-thirds of posterior surface of shaft.
Tibialis Posticus - Upper three-fourths of inner surface of shaft.

Added after completion of Part I.

A GRAPHIC PRESENTATION OF SOME OF THE PRINCIPAL DATES

OF THE

APPEARANCE OF THE SEVERAL CENTRES OF OSSIFICATION,

AND OF

THEIR UNION.

It is the Author's distinct experience that by far the easiest and most certain way to learn the centres of ossification, – with their dates of appearance and their dates of union, – is by repeatedly going over them, *in proper succession, on the actual bones*, – mainly on the articulated humerus, radius, ulna, – or femur, tibia, fibula, as the case may be, – the base of the skull, the spine on catgut, &c., – perhaps marking their situation with a piece of chalk, and, of course, distinctly rehearsing the corresponding weeks, months, or years.*

The following diagrams will be found to assist the student in this exercise. They are rough presentations of the bones above referred to, with the situations as above marked in numerical order, and briefly described.

They will further guard him against a real danger. They will prevent his getting *out of count*, so to speak, and thus learning the dates wrong, and then having them to unlearn and learn again.

Anyone who has attempted to count a number of objects very much alike, – say a number of railings surrounding an enclosure, or a number of similar chalk marks on a

(*Continued*, *p.* 178.)

* It will be seen that, in the matter of ossification, to know one's dates is practically to have mastered the entire subject. Any knowledge of Bone-Development worth speaking of must rest on familiar acquaintance with its chronology – with some hundred and fifty or two hundred dates of events which no ordinary student can witness, and having absolutely no connection one with the other. What the feat of memory involved in acquiring such familiarity must amount to may in a measure be judged of by comparison with the relatively quite simple matter, – difficult, however, to many, – of learning the surfaces and facets of the fifteen carpal and tarsal bones. Any help must be welcomed here.

DATES OF OSSIFICATION OF LONG BONES OF UPPER LIMB - Epiphyses. (Figures 173a to n.)

APPEARANCE OF CENTRES.

1ST OR 2ND YEAR.
1. Upper Ep. (head) of humerus.

2ND OR 3RD YEAR.
2. Lower Ep. of radius.
3. Capitellum & outer portion of trochlea of humerus.

3RD YEAR.
4. Greater tuberosity of humerus.

4TH OR 5TH YEAR.
5. Lower Ep. of ulna.

5TH YEAR.
6. Upper Ep. of radius.
7. Lesser tuberosity, and
8. Inner condyle of humerus.

10TH YEAR.
9. Upper Ep. of ulna (tip of olecranon).

11TH OR 12TH YEAR.
10. Inner portion of trochlea of humerus.

13TH OR 14TH YEAR.
11. Outer condyle of humerus.

UNION OF CENTRES.

16TH YEAR.
1. Upper Ep. of ulna.

16TH OR 17TH YEAR.
2. Outer condyle & the two portions of inferior articular surface of humerus.

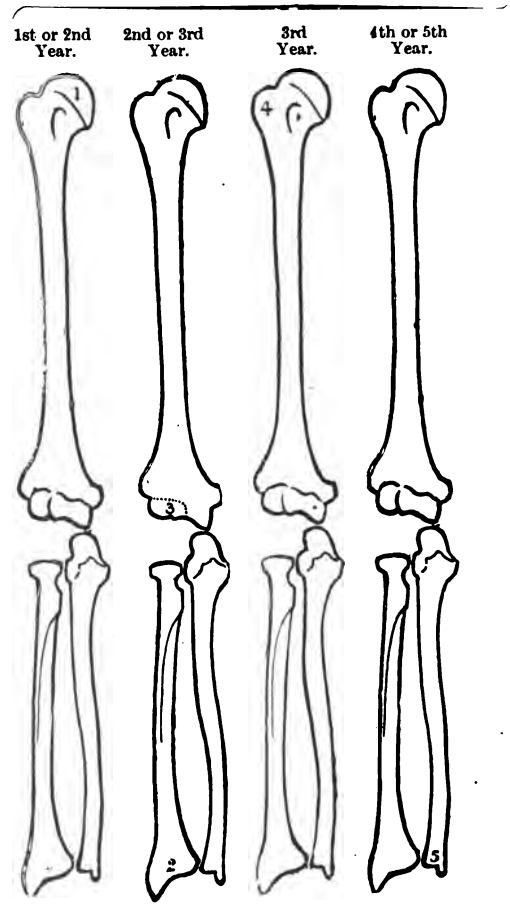
17TH OR 18TH YEAR.
3. Upper Ep. of radius.

18TH YEAR.
4. Inner condyle of humerus.

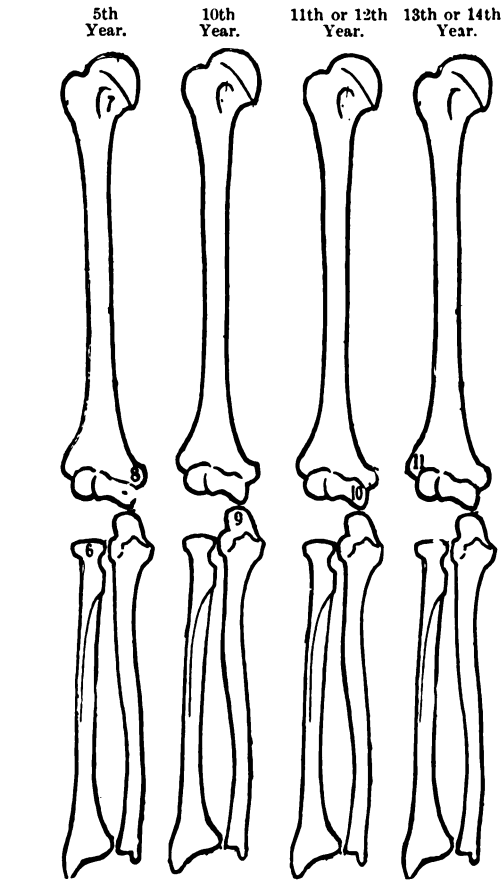
20TH YEAR.
5. Lower Ep. of radius.
6. Lower Ep. of ulna.

21ST YEAR.
7. Upper Ep. of humerus.

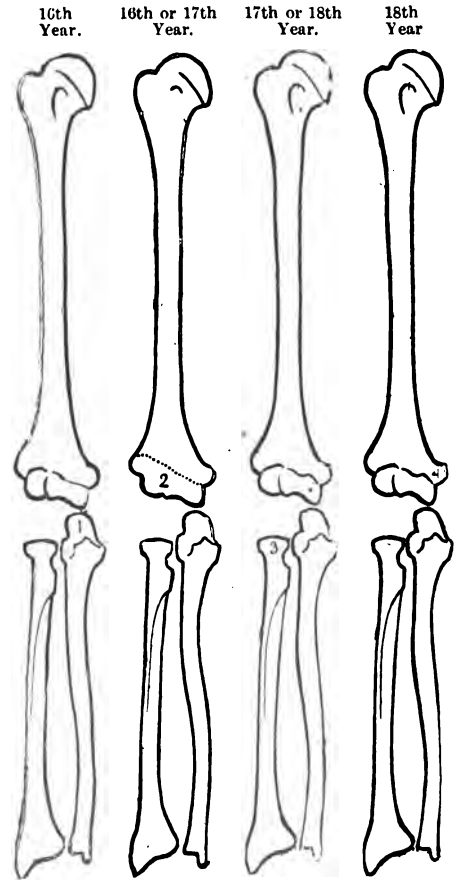
APPEARANCE



)F CENTRES.

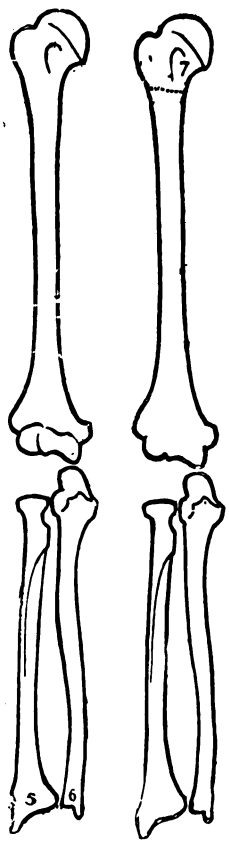


UNION OF



DATES OF OSSIFICATION OF LONG BONES OF LOWER LIMB – Epiphyses. (Figures 173n to x.)

CENTRES.



APPEARANCE OF CENTRES.

AT BIRTH.

1. Lower Ep. of femur.

1ST YEAR.

2. Upper Ep. of tibia.
3. Upper Ep. (head) of femur.

2ND YEAR.

4. Lower Ep. of tibia.
5. Lower Ep. of fibula.

4TH YEAR.

6. Upper Ep. of fibula.
7. Greater trochanter of femur.

13TH OR 14TH YEAR.

8. Lesser trochanter of femur.

UNION OF CENTRES.

17TH YEAR.

1. Lesser trochanter of femur.

18TH YEAR.

2. Lower Ep. of tibia.
3. Greater trochanter of femur.

19TH YEAR.

4. Head of femur.

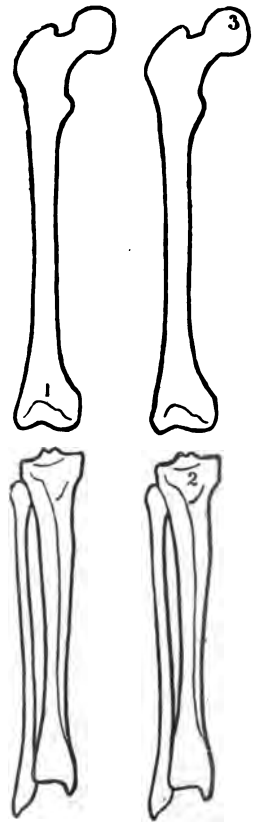
20TH YEAR.

5. Lower Ep. of femur.
6. Lower Ep. of fibula.
7. Upper Ep. of tibia.

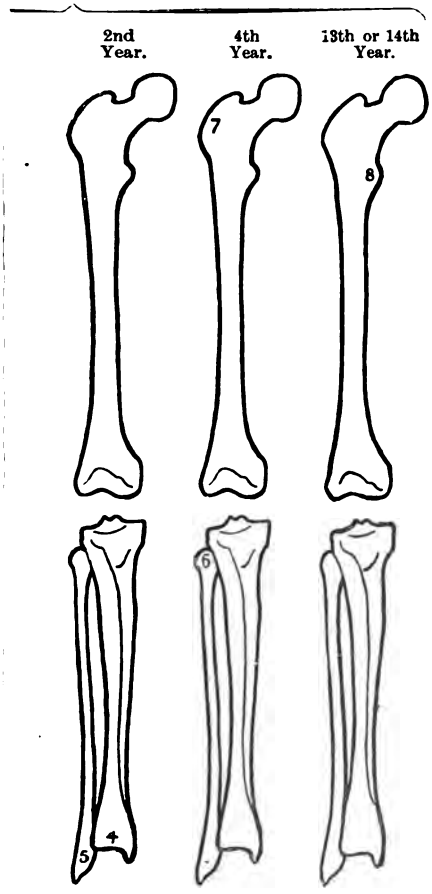
25TH YEAR.

8. Upper Ep. of fibula.

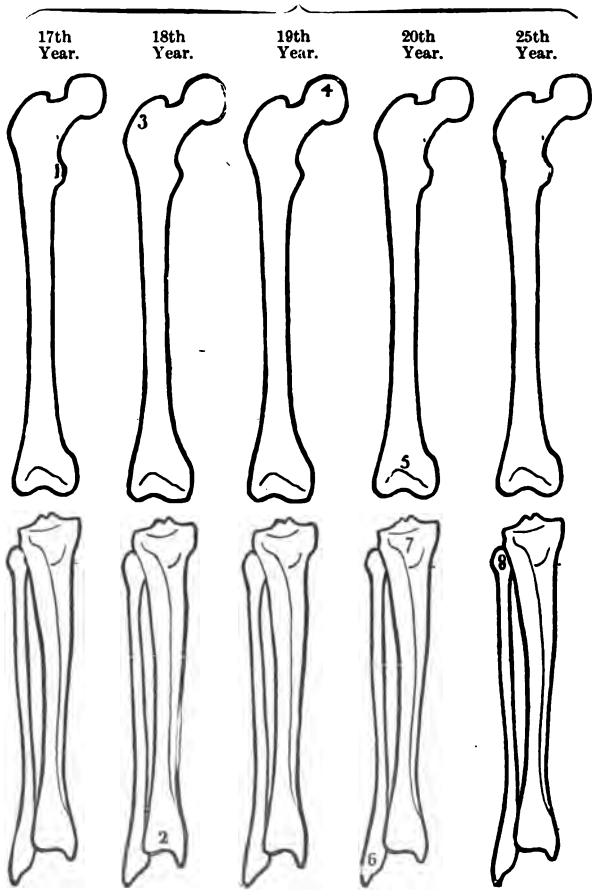
APPEAR



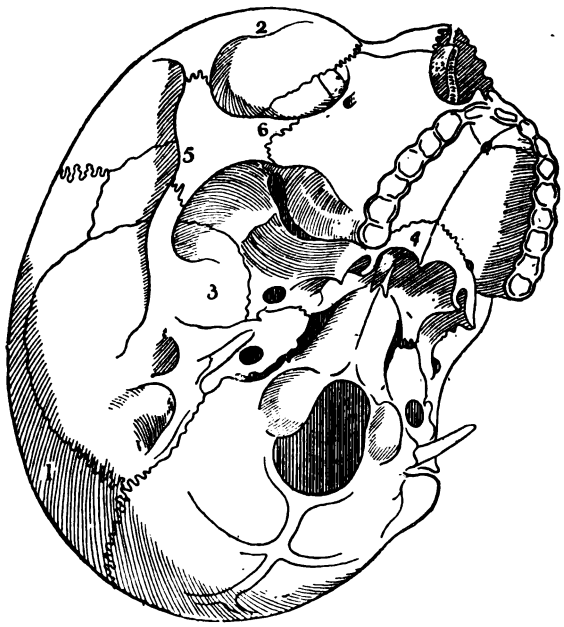
ANCE OF CENTRES.



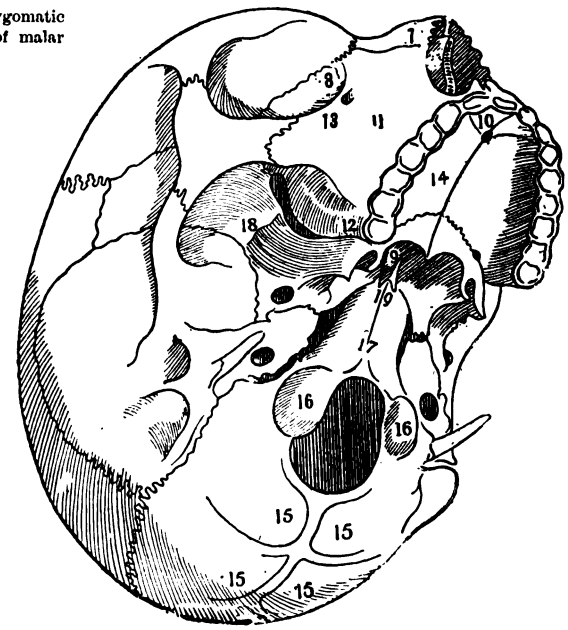
UNION OF CENTRES.



DATES OF OSSIFICATION OF THE BONES OF THE SKULL. (Figures 173x to ww.)

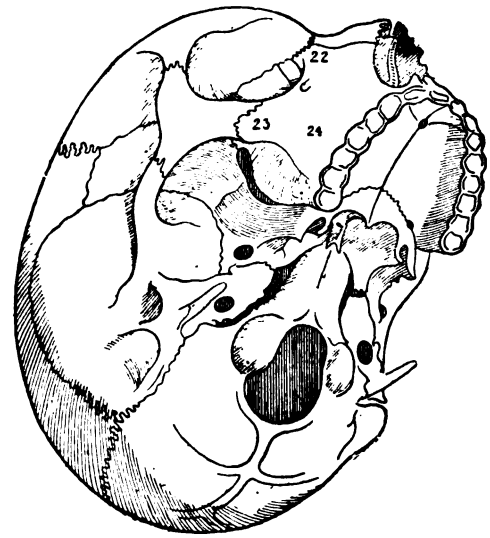


7TH OR 8TH WEEK.—Cs. for 1, parietal; 2, frontal; 3, squamo-zygomatic portion of temporal; 4, palate; 5, upper and larger portion of malar bone; 6, lower and smaller portion.



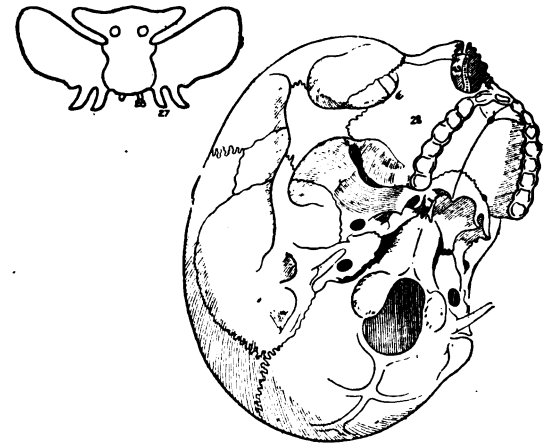
8TH WEEK.—Cs. for 7, nasal; 8, lachrymal; 9, vomer; 10, pre maxillary; 11, facial portion of superior maxilla; 12, back part of alveolus; 13, orbital plate; 14, palate process; 15, tabular; 16, condylar; 17, basilar portions of occipital; 18, great wing of sphenoid & external pterygoid plate; 19, posterior part of body.

9TH WEEK.—Cs. for 20, lesser wing of sphenoid ; 21, anterior part of body.

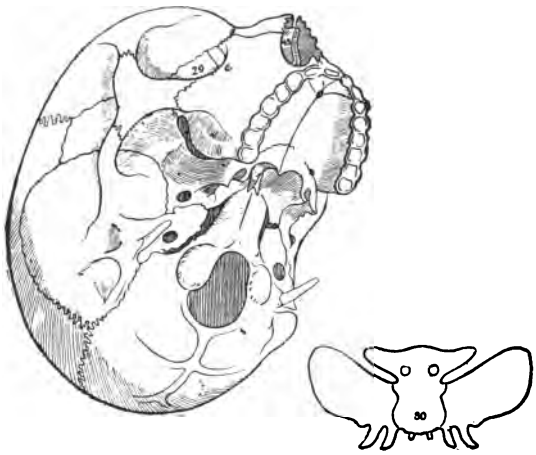


10TH WEEK.—Cs. for 22, nasal ; 23, malar processes of superior maxilla ; - 24, greater part of upper jaw united.

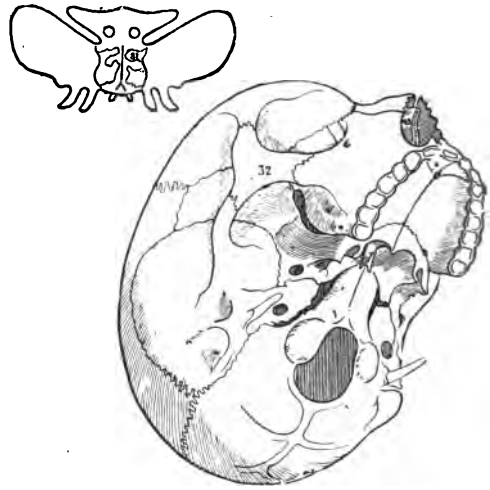
3RD MONTH.—C. for 25, tympanic portion of temporal bone.



4TH MONTH.- C. for 26, lingula of sphenoid ; 27, interior pterygoid plate ; - 28, antrum excavated.



4TH OR 5TH MONTH.—C. for 29, lateral mass of ethmoid; - 30, union of Cs. for posterior portion of body of sphenoid.

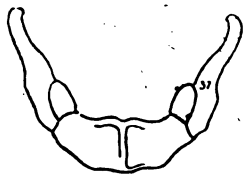


5TH MONTH.—Cs. for 31, spheno'dal turbinated bones; 32, the two portions of malar bone united.

5TH OR 6TH MONTH.—33, the six Cs. for petro-mastoid portion of temporal. (*See* Fig. 175.)

6TH MONTH.—34, internal pterygoid plate joined to external.

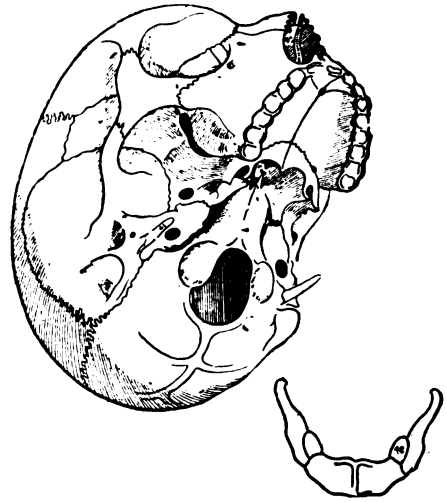
8TH MONTH.—C. for 35, body of hyoid bone; - 36, union of pre- and post-sphenoid.



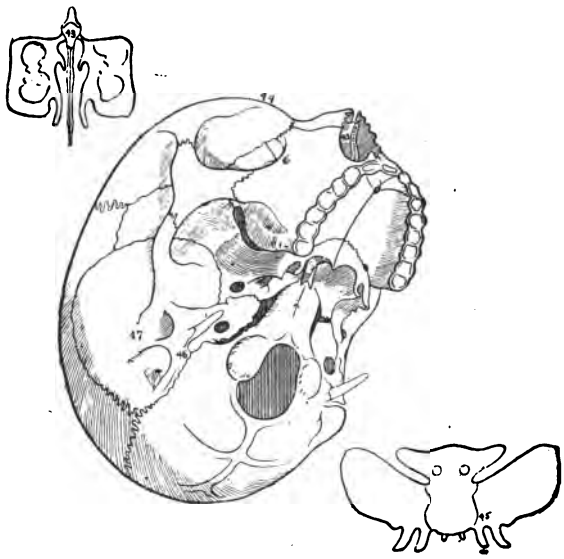
9TH MONTH.—C. for 37, greater cornu of hyoid bone.

BEFORE BIRTH.—C. for 38, tympano-hyal; 39, tympanic portion of temporal bone joins squamo-zygomatic.

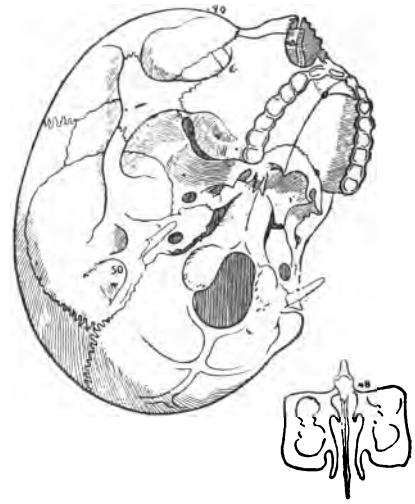
AT BIRTH.—40 lesser wing of sphenoid joins front part of body.



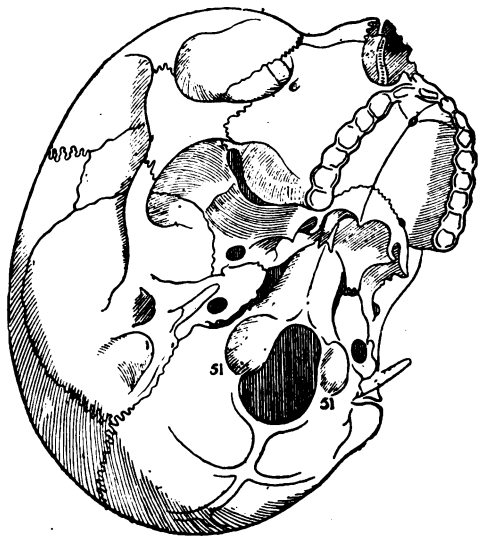
AFTER BIRTH.—Cs. for 41, stylo-hyal; 42, lesser cornua of hyoid bone.



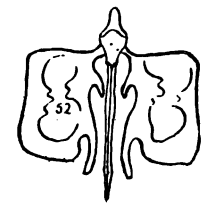
1ST YEAR.—C. for 43, horizontal & perpendicular plates of ethmoid; - 44, union by suture of two halves of frontal bone; 45, greater wings and external pterygoid plates of sphenoid joined to body; 46, tympano-hyal; and 47, squamo-zygomatic portions of temporal joined to petro-mastoid.



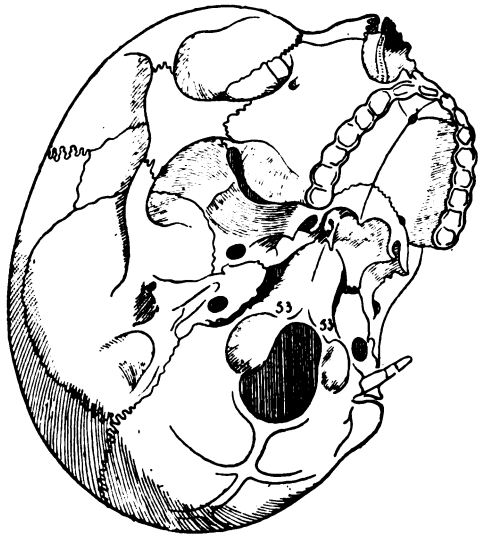
2ND YEAR.—48, union of lateral mass of ethmoid with horizontal and perpendicular plates; 49, fusion of two halves of frontal bone; 50, mastoid process begins to protrude.



4TH YEAR.—51, union of tabular & condylar portions of occipital.



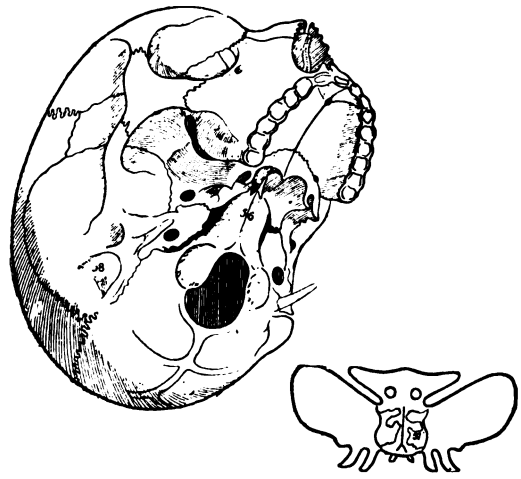
4TH OR 5TH YEAR.—52, ethmoid cells excavated.



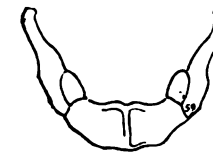
6TH YEAR.—53, union of condylar & basilar portions of occipital.

10TH OR 12TH YEAR.—54, union of sphenoid & sphenoidal turbinated bones begins.

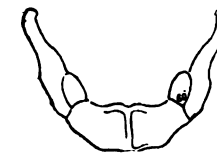
PUBERTY.—55, stylo-hyal may join tympano-hyal; union may be indefinitely postponed.



18TH OR 20TH YEAR.—56, basilar portion of occipital joins body of sphenoid; 57, completion of union between sphenoid & sphenoidal turbinated bones; 58, mastoid cells excavated



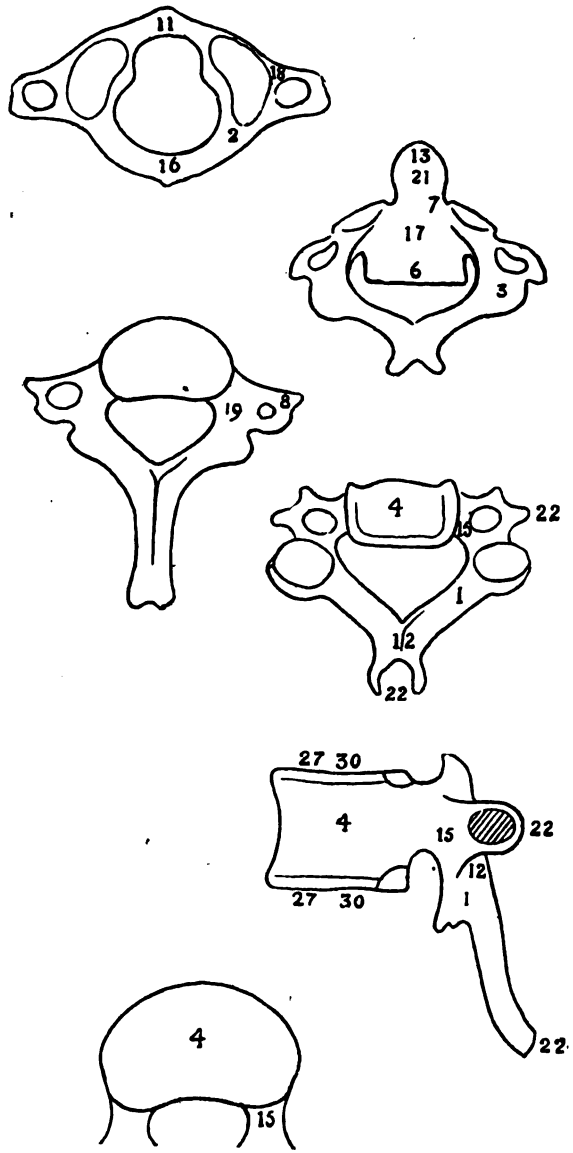
MIDDLE OF LIFE.—59, union of body & greater cornua of hyoid bone.



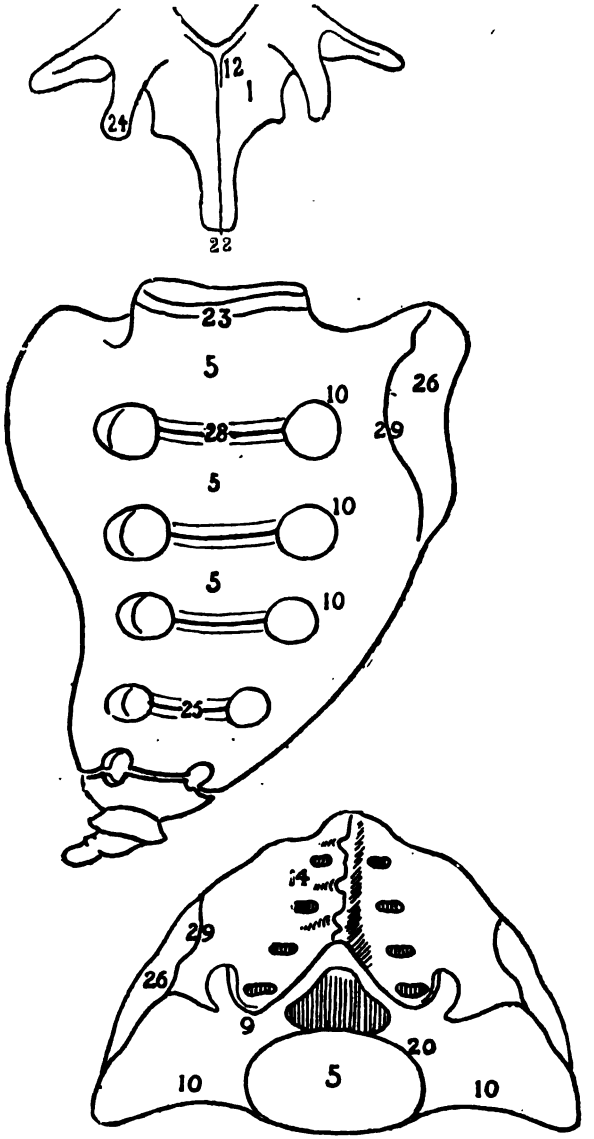
ADVANCED AGE.—60, union of body & lesser cornua of hyoid bone]

DATES OF OSSIFICATION OF THE SPINE. (Figures 173ww to fff.)

1. Lateral centres of vertebræ generally (laminæ, processes, & lateral parts of body).	6	WEEKS.
2. Lateral centres of atlas.	7	
3. Lateral centres of axis.	7 or 8	
4. Central centres of vertebræ generally (central & greater part of body).	8	
5. Central centres of three upper sacral vertebræ; central centres of two lower sacral vertebræ a little later.	8 or 9	
6. C. for lower part of body of axis. 7. C. for lower part of odontoid process. 8. C. for anterior part of transverse process of 7th cervical vertebra. 9. Cs. for arches of sacral vertebræ.	6	MONTHS.
10. Cs. for anterior transverse processes of three upper sacral vertebræ.	7	
11. Occasional C. or Cs. for anterior arch of atlas. 12. Union of laminæ (arches) of vertebræ generally.	1	
13. C. for apex of odontoid process of axis. 14. Union of arches of sacral vertebræ with the bodies and with each other begins in the lower sacral vertebræ.	2	
15. Union of arches of vertebræ generally with bodies. 16. Union with each other of the two arches of the atlas (frequently preceded by appearance of a median centre). 17. Lower part of odontoid process of axis joined to body.	3	



	YEARS.
18. Anter or arch of atlas (when ossified separately) joined to lateral mass. 19. Anterior part of transverse process of 7th cervical vertebra joined to posterior part & body. 20. Union of arches of sacral vertebræ with bodies and with each other completed in upper sacral vertebræ.	5 or 6
21. Apex of odontoid process joined to lower part of same.	12
22. Cs. for tips of spinous & transverse process of vertebræ generally. 23. Cs. for epiphysial plates of bodies of sacral vertebræ.	16
24. Cs. for mammillary tubercles on back of superior lumbar articular processes.	17
25. Ossification of sacral intervertebral discs commences in lower sacral vertebræ.	18
26. Cs. for auricular surfaces and borders of sacrum.	18 or 20
27. Cs. for epiphysial plates of vertebræ generally.	21
28. Union of bodies of two first sacral vertebræ by ossification of intervertebral disc between them. 29. The two auricular plates of sacrum join with the remainder of the bone.	25
30. Epiphysial plates of vertebræ generally joined to bodies.	30



(*Continued from page* 165.)

blackboard, – will have noticed how easily in such cases the eye loses its bearings. Something very similar is found to occur in regard to the grasp by the mere memory of a number of dates or other symbols.

The fact, to the Author's mind, should involve the condemnation of all kind of mere memory work.

But if such work has to be done as in "getting up" the series of numerals here presented,* it will be found a great relief to have a means of segmenting the series, so to speak, by some kind of rallying points.

Such rallying points are most conveniently supplied in the present case by the several dates referring to the sphenoid. This bone has its dates of ossification most widely scattered, indeed practically covering the whole ossification period. The Author would press that, in regard at least to the ossification of the skull, this bone should first be thoroughly learnt, and then the dates referring thereto carried mentally throughout the entire series of dates presented by the other bones.†

But of the whole thing may it not be asked, *Cui bono?* That the dates of union with the shaft of the epiphyses of certain of the long bones, more particularly those of the lower limb, are important in surgery, is of course evident. But this is a point which should come in, it is submitted, in connection with the customary clinical remarks on joint-excisions and on the separation of epiphyses. Such remarks deal with dates *very roughly given.* Is there any real advantage in the greater precision with which the matter is dealt with in connection with the question of ossification? It is believed not. And is there any real advantage *to the practitioner* in extending the detailed investigation to all the bones of the body? It is also believed not. Where are the surgeons of any standing who could correctly go through the entire series of the dates of ossification, or even any considerable portion thereof? Rather are not those who can accomplish such feat at a real disadvantage in regard to becoming surgeons in the proper sense of the term? Such must have had their attention turned away for long periods from observing in any true sense, and riveted on mere mechanical remembering.

It is believed that the dates referring to the short and flat bones have been more than sufficiently presented in the first instance.

The accompanying diagrams have been very skilfully drawn for the Authors by Mr. Sidney Maynard Smith, of St. Mary's Hospital.

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* But has it to be done? Referring to such an all-important structure as the spine, it will be admitted that everybody should know that the lateral centres of the vertebræ appear before the central centres, that the two halves of the vertebral arches are joined to each other before the arches are joined to the bodies, &c.; but would even the most insatiable crammer maintain that there is anything to be gained by getting up all the thirty dates given on pages 176 and 177?

† The temporal bone comes next to the sphenoid in the special respect referred to; and its dates might be similarly utilised.

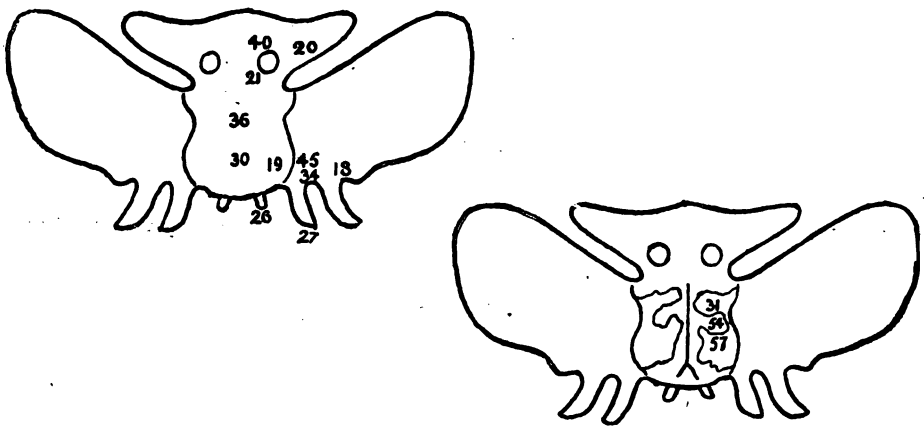

FIG. 173hhh.—THE DATES OF OSSIFICATION OF THE SPHENOID.

18. } 8th Week— { C. for great wing and external pterygoid plate.
19. } { C. for posterior part of body.
20. } 9th Week— { C. for lesser wing.
21. } { C. for front part of body.
26. } 4th Month— { C. for lingula.
27. } { C. for internal pterygoid plate.
30. 4th or 5th Month—Union of Cs. for posterior part of body.
31. 5th Month—C. for sphenoidal turbinated bone.
34. 6th Month—Internal pterygoid plate joined to external.
36. 8th Month—Union of pre- and post-sphenoid.
40. At Birth—Lesser wing joins front part of body.
45. 1st Year—Greater wing and external pterygoid plate joined to body.
54. 10th or 12th Year—Union of sphenoid and sphenoidal turbinated bones begins.
57. 18th or 20th Year—Completion of union of sphenoid and sphenoidal turbinated bones.

N.B.—The numerals in the above Figure and list range with those given in respect of the ossification of the skull generally on pp. 170 to 175.

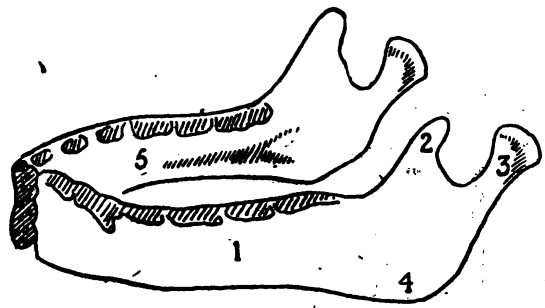

FIG. 174.—THE SUCCESSION OF CENTRES FOR THE LOWER JAW APPEARING IN THE 5TH WEEK, OR A LITTLE LATER. (*See* p. 150.)

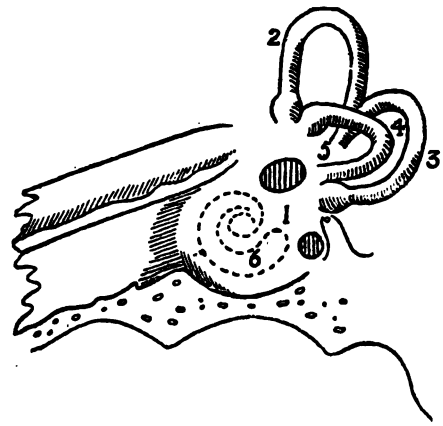

FIG. 175.—THE SUCCESSION OF CENTRES FOR THE PETRO-MASTOID PORTION OF THE TEMPORAL BONE APPEARING ABOUT THE 5TH MONTH. (*See* p. 154.)

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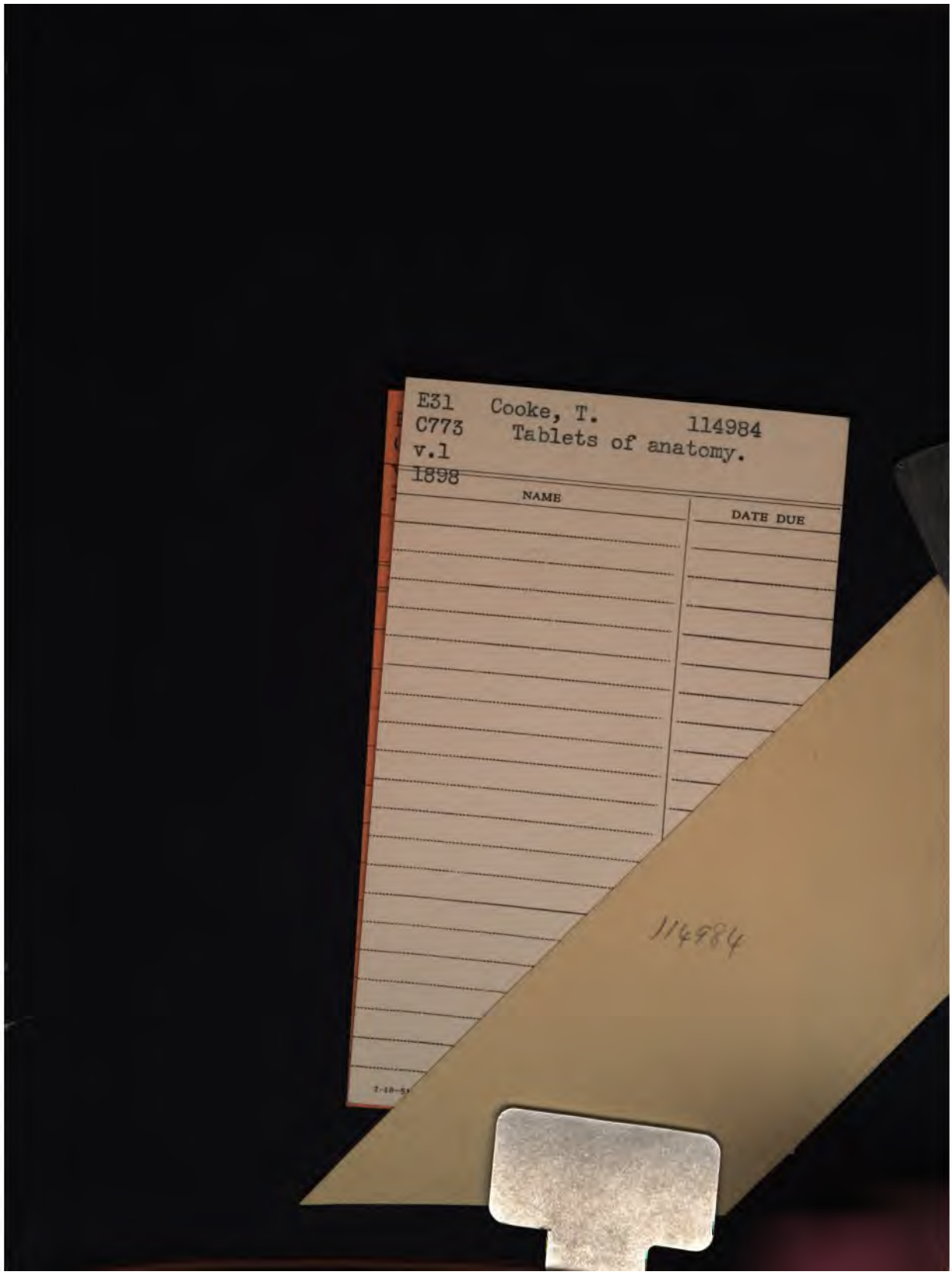
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